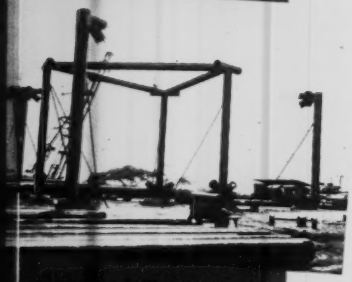
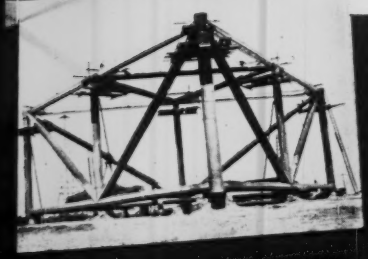
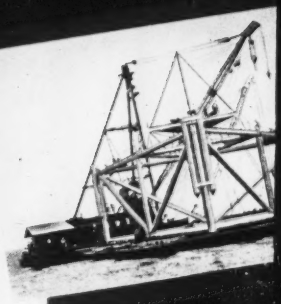
CIVIL ENGINEERING

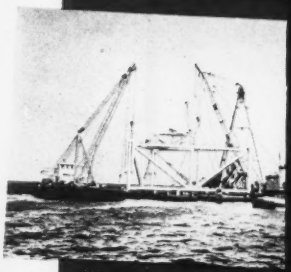
CAISSONS for bridge at Yorktown, Va., erected in drydock. Quade and Vaccaro.

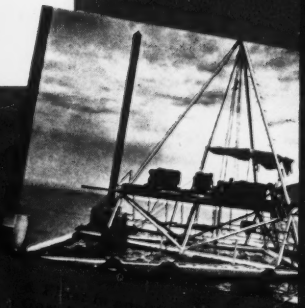
THE WORLD'S MOST UNUSUAL SOIL BORING JOB











The Problem: 250-foot Gow soil borings, accurately spotted five to ten miles offshore in the deep waters of Lake Maracaibo, Venezuela. The Project: pile foundations for future oil-well derricks. Special Hazard: 70-mile-an-hour "chubascos," violent squalls that would wreck temporary platforms.

The Solution: Raymond engineers designed a triangular *floating* platform of 22" steel pipe, welded and watertight. The three corner members were left open for 120-foot-long anchor spuds. Assembled on shore from steelwork fabricated in New York, the 60-ton float was skidded onto two barges and towed 32 miles to the first boring location where floating derricks launched it. Spuds and deck equipment were placed later, including winch-controlled anchors at each corner to help in spotting the float and holding it steady during boring operations.

The Moral: When the problem is tough, the answer must still be *right*. That's when it pays to have a resourceful, experienced organization on the job . . . like Raymond!

AROUND THE WORLD FOUNDED 1891

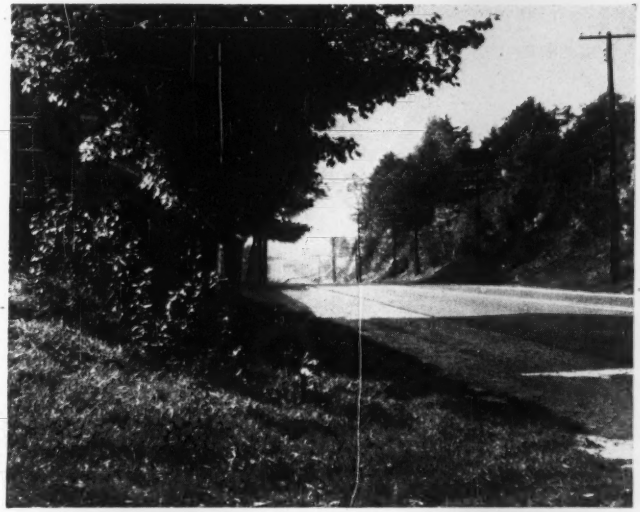
Raymond

CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

LET SUMMERS COME...and WINTERS GO

THESE ROADS WILL SERVE YOU WELL...



Blending with every landscape and free from glare, roads built with Tarvia* road tar take the strain out of driving. They are self-healing under impacting traffic.

The heat-absorbing qualities of black roads built with Tarvia* road tar make them easier to keep open in winter, as snow and ice melt more quickly. And they are not affected by chemicals used to remove snow and ice

because

1 Roads built with Tarvia* road tar improve with age. Occasional applications will renew the life of the surface, and replace worn-away material.

2 TARVIA road tar penetrates surfaces and binds together the underlying material. It thus makes possible the inexpensive use of local aggregates.

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5 TARVIA road tar holds the aggregate tightly in the surface, and produces a gritty surface which is lastingly skid-resistant.

6 TARVIA road tar may be applied at moderate temperatures, and with ordinary equipment.

The Barrett field man is always at your call for expert practical advice.

Barrett* Tarvia* ROAD TAR

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CIVIL ENGINEERING, The Magazine of Engineered Construction, February, 1951. Vol. 21, No. 2. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1918, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

IN ~~1950~~ 1951

FOR THE ~~13th~~ 14th CONSECUTIVE YEAR

No other graders will perform so many construction and maintenance jobs so well as the 88-H...99-H...and MASTER 99

The Power Graders that Have Everything

★ All-Wheel Drive ★ Precision Sideshift ★ High-Lift Blade ★ Completely Reversible Blade
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BUILDERS OF ROAD MACHINERY
Austin Western
SINCE 1859

Get NEW efficiency for OLD pipe lines

—at a fraction of new pipe line costs

Unretouched photo of section of old pipe before being reconditioned.

Similar section after being cleaned, ready for lining.

Typical section after being cement-mortar lined by the Tate process.

TATE PROCESS applies cement-mortar lining to water, oil and gas pipe lines in place

Could the operation of your pipe line be improved? Whether it is of steel or cast iron, here is the way this famous process can help you get better performance from old lines.

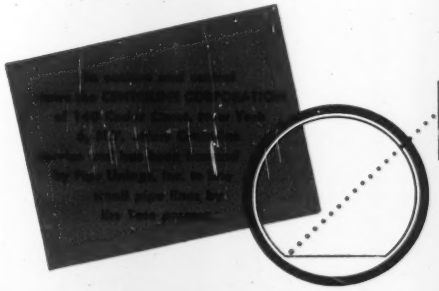
- Restores flow coefficients
- Reduces pumping costs
- Reduces maintenance costs
- Prevents leakage
- Protects against corrosion
- Protects against discoloration and contamination

This process produces a thorough reconditioning of old pipe lines, without discontinuance of service. With specially designed, patented equipment, it cleans corroded matter and tubercles from pipe line walls. Then it applies a cement-mortar lining to the walls, varying its thickness according to need.

The result is a smooth, strong, permanent lining that restores the original efficiency of the line at much less expense than the cost of a new line. It is effective for protecting and greatly extending the life of new steel lines as well as for renewing old ones. Pipes of all diameters from 4" upwards can be serviced. The Tate process is especially adapted to lines from 4" to 16" in diameter. Larger lines are reconditioned by the Centriline process.

Ever-increasing demand for these services and millions of feet of reconditioned lines that have been in operation for years are evidence of their value. It will pay you to investigate.

Write for complete details today.



PIPE LININGS, Inc.

A subsidiary of
AMERICAN PIPE AND CONSTRUCTION CO.
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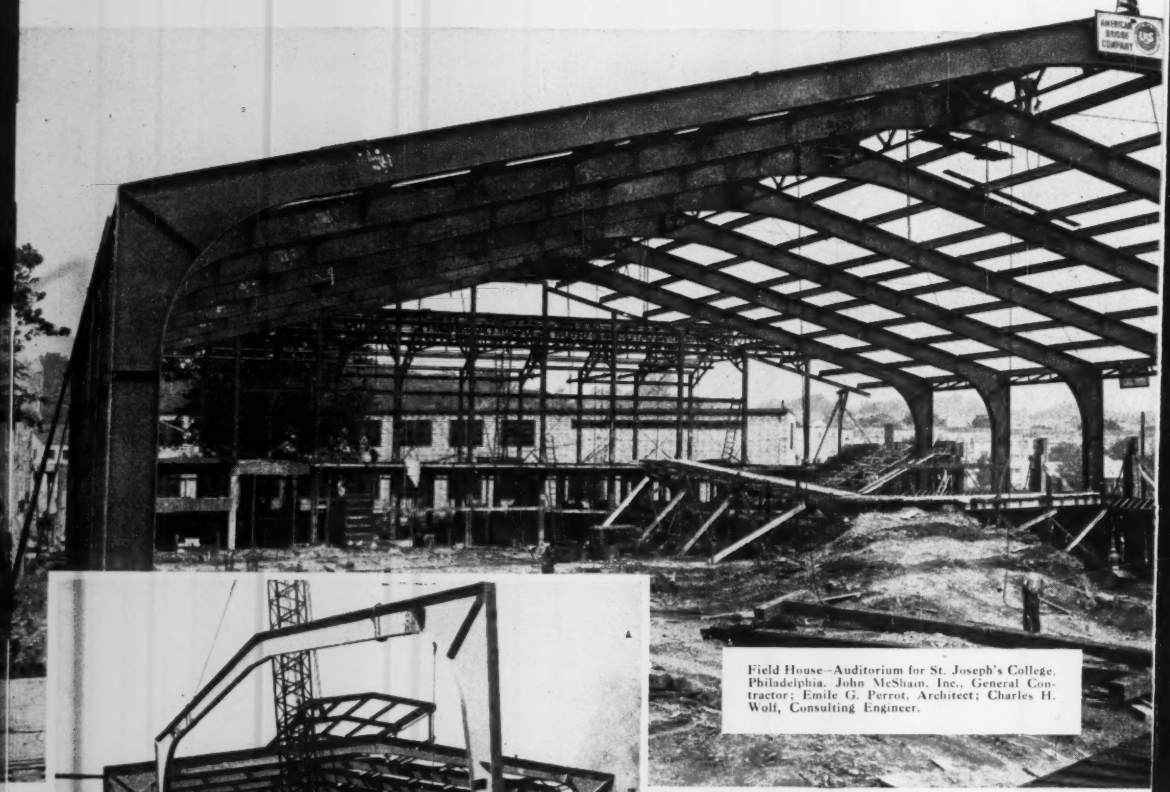
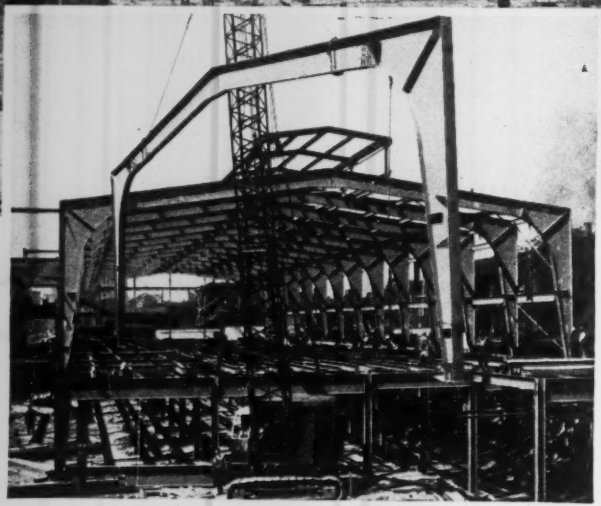
RIGID-FRAME STEEL CONSTRUCTION

Gives more usable floor space! • Saves erection time and costs!



Field House—Auditorium for St. Joseph's College, Philadelphia. John McShain, Inc., General Contractor; Emile G. Perrot, Architect; Charles H. Wolf, Consulting Engineer.



Bottling plant and case warehouse, Detroit, Michigan, for The Stroh Brewery Company. Harley, Ellington and Day, Inc., Architects and Engineers.

THESE two buildings, fabricated and erected by American Bridge Company, serve to illustrate some of the advantages of rigid-frame steel construction. The unobstructed floor area, the speed of erection, neat appearance, and economy which this type of construction provides may save money for you. For information on all types of construction, consult our nearest Contracting Office.

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THESE power twins are the largest earthmovers ever engineered by "Caterpillar." They combine high speeds with high capacities to meet today's demands for increased production for both civilian and military needs. They give construction men the choice of two or four wheels in husky hustlers built to stand up under the toughest going.

For big production on long hauls, you can't beat the 4-wheel "Cat" DW20 with its top speed of 26.6 m.p.h. The DW20 offers two matched trailer units. The W20 Wagon—heaped capacity, 25 cu. yds. And the No. 20 Scraper—heaped capacity, 19½ cu. yds. The DW20 is also available with the No. 20S Bulldozer.

For big production on jobs best suited to 2-wheel rigs, you've got the edge with the "Cat" DW21. Trailing the No. 21 Scraper, which has a heaped capacity of 19½ cu. yds., its top speed is 20 m.p.h.

Both these speedy giants are powered by the new 6-cylinder "Cat" Diesel Engine, producing 225 HP. available at the flywheel. For complete data, see your "Caterpillar" dealer. Under today's conditions, it's a good move to talk over your requirements *now* with him. He's as close as your phone for service or information—call him today!

CATERPILLAR, PEORIA, ILLINOIS

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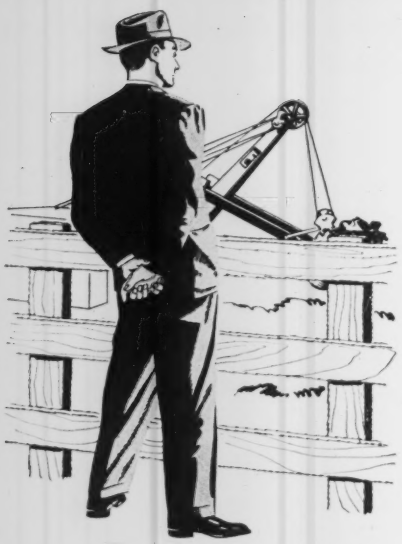
EARTHMOVING EQUIPMENT



who's this *Sidewalk Superintendent?*

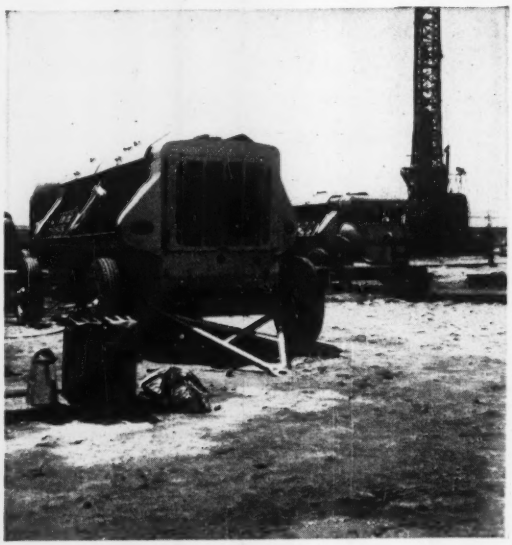
He's a Gardner-Denver field engineer away from the office—watching construction problems as they turn up. He knows first hand just what you expect construction equipment to do for you.

Gardner-Denver Portables, for example, are tops in dependability...

Because they are *all* water-cooled — all the way down the cylinder. You can bank on Gardner-Denver Two-Stage Portable Compressors for steady going regardless of temperature, weather or altitude.

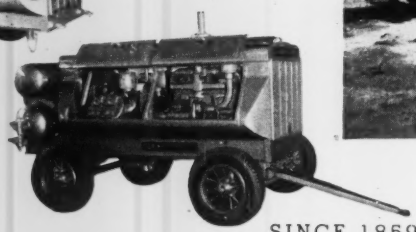
Choose any size Gardner-Denver Portable — from 105 to 500 cubic feet actual capacity—for the best protection against compressed air emergencies.

Bulletins PC-12 and PC-15 give all the facts on diesel and gasoline engine driven models. Write us today!



Model WH-500D

Model WH-105



Model WH-315

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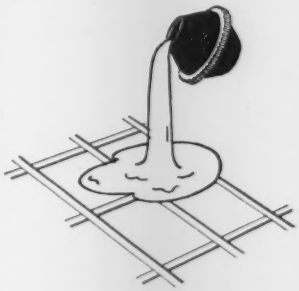
For the toughest drainage jobs... concrete pipe reinforced with American Welded Wire Fabric

ON the nation's highways, railroads and airports, the tremendous volume of surface run off is handled most efficiently by reinforced concrete pipe. In water supply and sewer systems, too, reinforced concrete pipe handles the volume, withstands the pressure, maintains effective leakage limits.

Prominent fabricators have established uniform specifications for the manufacture of reinforced concrete pipe. Those specifications meet the standards set by the A.S.T.M. And an impressive proportion of the industry's output is reinforced with American Welded Wire Fabric, the *reinforcement* for concrete that meets all A.S.T.M. requirements.

American Welded Wire Fabric distributes the strength of high yield point steel throughout all parts of the pipe and forms a perfect bond with concrete. The welded fabric can be quickly and easily shaped into cages to fit molds that produce pipe sections of various diameters and lengths. The reinforcement stays in place during pouring and tamping.

So, when you are planning projects that require reinforced concrete pipe, be sure the pipe you get is reinforced with U·S·S American Welded Wire Fabric.



AMERICAN STEEL & WIRE COMPANY, GEN. OFFICES: CLEVELAND
COLUMBIA STEEL COMPANY, SAN FRANCISCO
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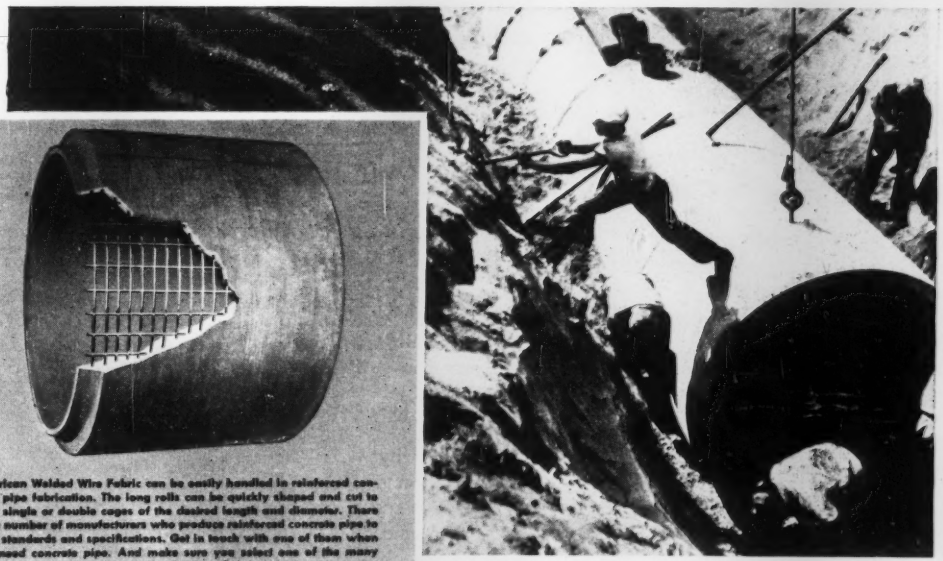
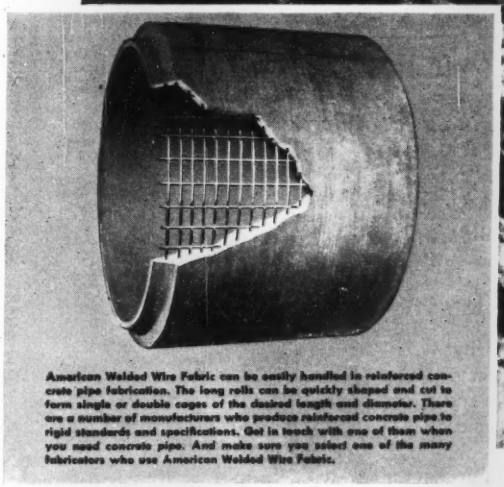




American Welded Wire Fabric can be easily handled in reinforced concrete pipe fabrication. The long rolls can be quickly shaped and cut to form single or double cages of the desired length and diameter. There are a number of manufacturers who produce reinforced concrete pipe to rigid standards and specifications. Get in touch with one of them when you need concrete pipe. And make sure you select one of the many fabricators who use American Welded Wire Fabric.

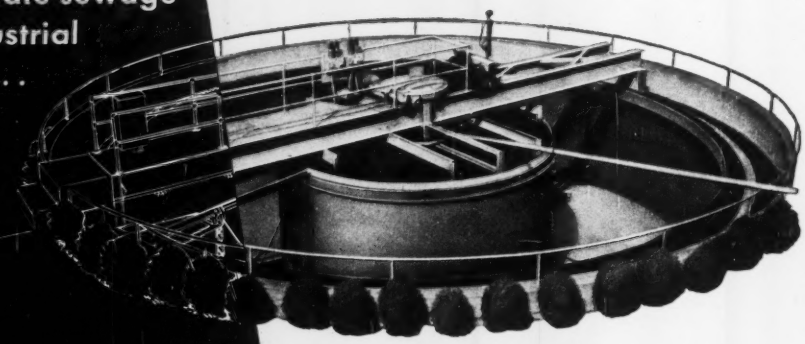
Every type of concrete construction needs

USS **AMERICAN WELDED WIRE FABRIC**
reinforcement

UNITED STATES STEEL

new and better way

to preaerate sewage and industrial wastes . . .



the low cost **DORRCO AERATOR-CLARIFIER**

The new Dorrco Aerator-Clarifier is a compact, low-cost unit combining the functions of *preaeration*, *flocculation* and *sedimentation* in a single tank. It is applicable wherever it is advantageous to increase suspended solids and B.O.D. removals—where odor control or elimination is necessary—or where flocculation with or without chemicals, is beneficial. It fits equally well into primary or secondary treatment flowsheets . . . with notable advantages in both.

Highlights of Aerator-Clarifier superiority are listed at the right, but it will pay you to check the complete story of the design and operating characteristics. A Dorr engineer will gladly tell you more . . . without obligation.

DORRCO AERATOR-CLARIFIER ADVANTAGES as compared with separate preaeration and sedimentation tanks.

1. **Compact** . . . single tank saves ground space.
2. **No solids interference in aeration chamber** . . . grit and heavier solids settle quickly, avoiding interference with flocculant material.
3. **No breakup of floc structure** . . . low transfer velocities from Aerator to Clarifier section eliminates breakup of flocculated material.
4. **Minimum of short circuiting** . . . spiral-flow aeration effect in Aerator minimizes short circuiting.
5. **Simple maintenance** . . . aeration tubes are removable for cleaning or replacement without interfering with operation of the unit.
6. **Low cost** . . . single tank and simple design cut installed cost.

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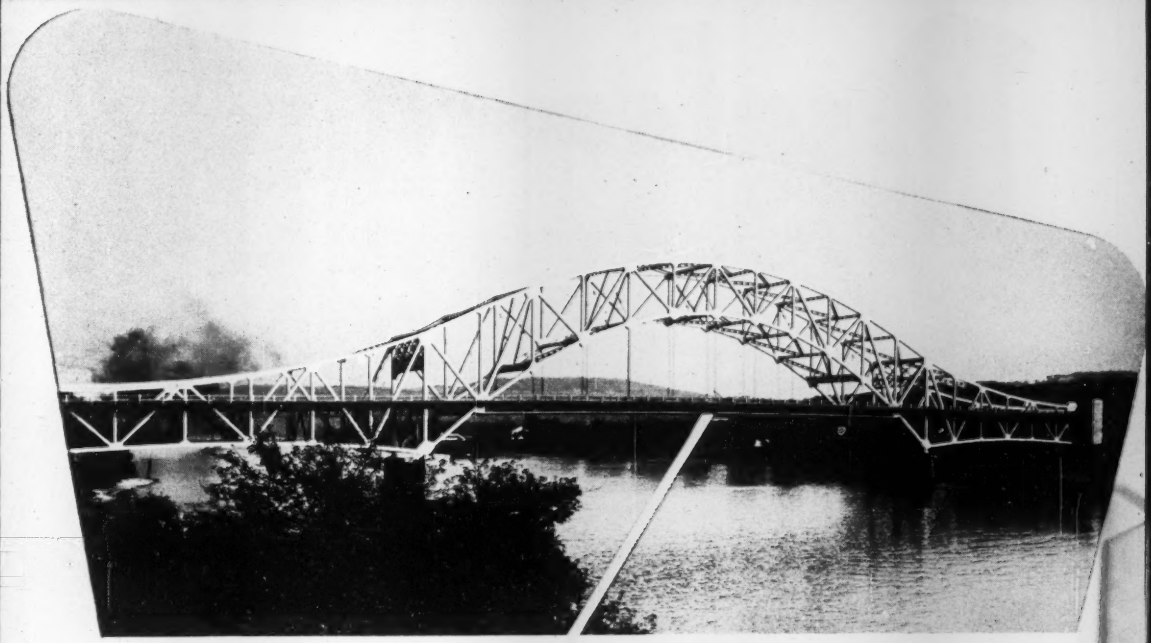
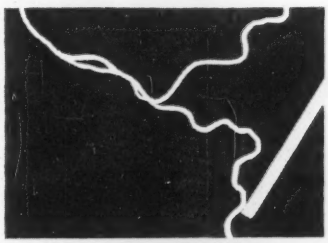


The New Elizabeth, Pennsylvania Bridge has now been completed by

FORT PITT BRIDGE



There are more Steel Bridges over the three rivers in the Pittsburgh district than in any other area of comparable size in the world.

Fort Pitt Bridge is proud of the important role they have played in the construction of many of these steel structures.

By-passing the congested traffic areas of Elizabeth, Pennsylvania, this new four-lane STEEL BRIDGE spanning the Monongahela River a few miles south of Pittsburgh will mark another new connecting link in Pennsylvania's great highway system. Driving throughout the main arteries of this state, including the famed Pennsylvania Turnpike from the Ohio line to Philadelphia, you will see tangible evidence of the beauty, strength and durability of steel bridges, many of which have been fabricated and erected by *Fort Pitt Bridge*.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION INC. AISC FOUNDED 1921

"Steel Permits Streamlining Construction with Safety, Endurance and Economy"

Fort Pitt BRIDGE WORKS

Member American Institute of Steel Construction

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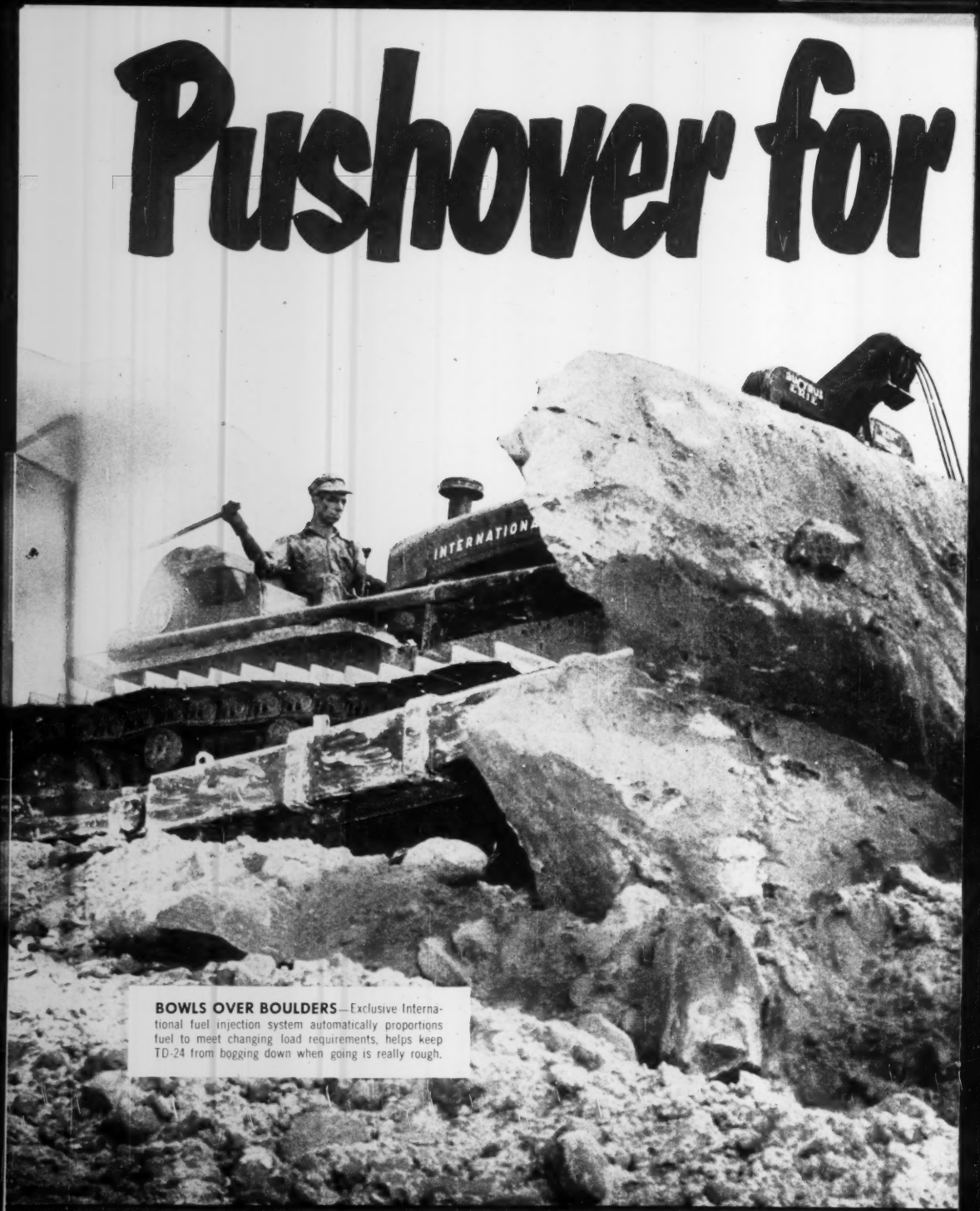
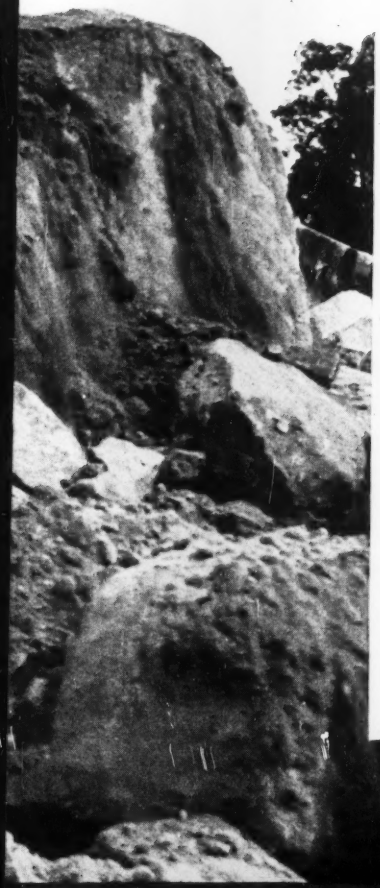
Pushover for



BOWLS OVER BOULDERS—Exclusive International fuel injection system automatically proportions fuel to meet changing load requirements, helps keep TD-24 from bogging down when going is really rough.

the Champ



The champ makes it look easy. The champ has the crowd with him. The champ takes on all comers.

What makes the champ the champ?

In a man it's guts, strength, skill and a fighting heart.

In the TD-24 it's gears, metal and go, translated into irresistible strength, stamina and "handle-ability."

Here are a few things that make the biggest job a pushover for the TD-24.

148 maximum drawbar horsepower—more than any other crawler.

Eight forward speeds, eight reverse.

Speeds up to 7.8 mph in either direction.

Synchromesh transmission—you "shift on-the-go."

Exclusive International push-button, all-weather starting.

Planet Power steering, finger-tip control for pivot turns, feathered turns, turns with power on both tracks plus instant shift up or down one gear without declutching.

Reserve torque to make the TD-24 hang on to overloads and walk away with as much as ten cubic yards on the blade.

The word is out on the "grapevine." At conventions, bid-openings, contract-lettings, contractors are telling each other how the TD-24 does more work with more speed—has more lugging ability—moves more pay-dirt faster than any other crawler on the market.

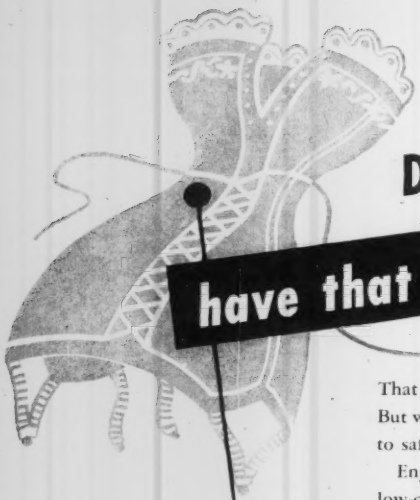
Want more facts . . . more proof? Ask your International Industrial Distributor for the low-down on the TD-24. You'll be a TD-24 man from then on in!

INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

POWER THAT PAYS

INTERNATIONAL

INTERNATIONAL HARVESTER



Do your highways have that "GAY NINETIES" look?

That pinched waist look may have been alright on a "gay nineties" girl. But when caused by narrow bridges on your highways it is a definite hazard to safety and smooth flowing traffic.

Engineers have found that Armco Drainage Structures provide a simple low-cost answer. When the original structure is sound, the desired extra width can frequently be provided by extending with Armco MULTI-PLATE or Corrugated Metal Pipe. Failing structures can be economically relined and extended, or completely replaced if necessary.

But this is just one example of the way Armco Drainage Structures are helping engineers make needed improvements at low cost.

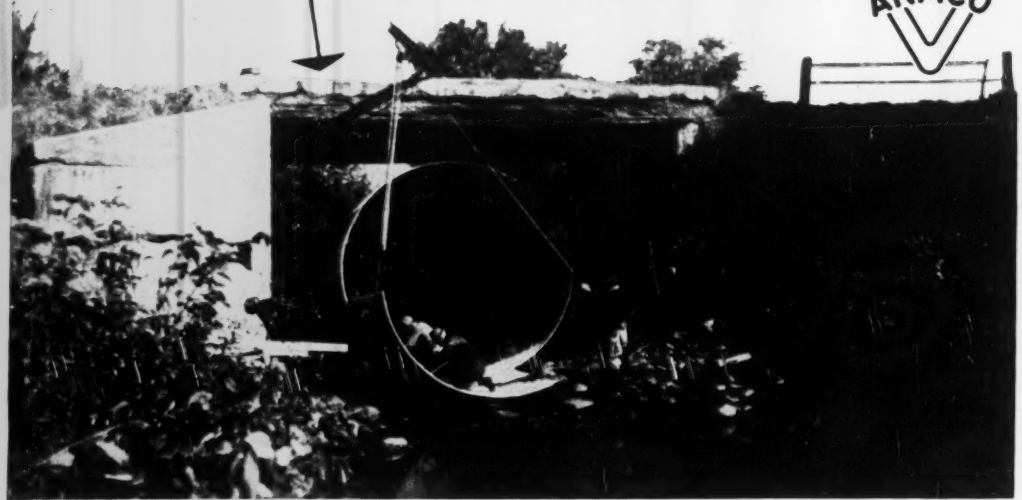
You'll also be interested in Armco PIPE-ARCH, as an answer to limited headroom; Armco PAVED-INVERT Pipe to guard against erosion; and Armco ASBESTOS-BONDED Pipe (a completely new idea in metal protection) to meet severe corrosion.

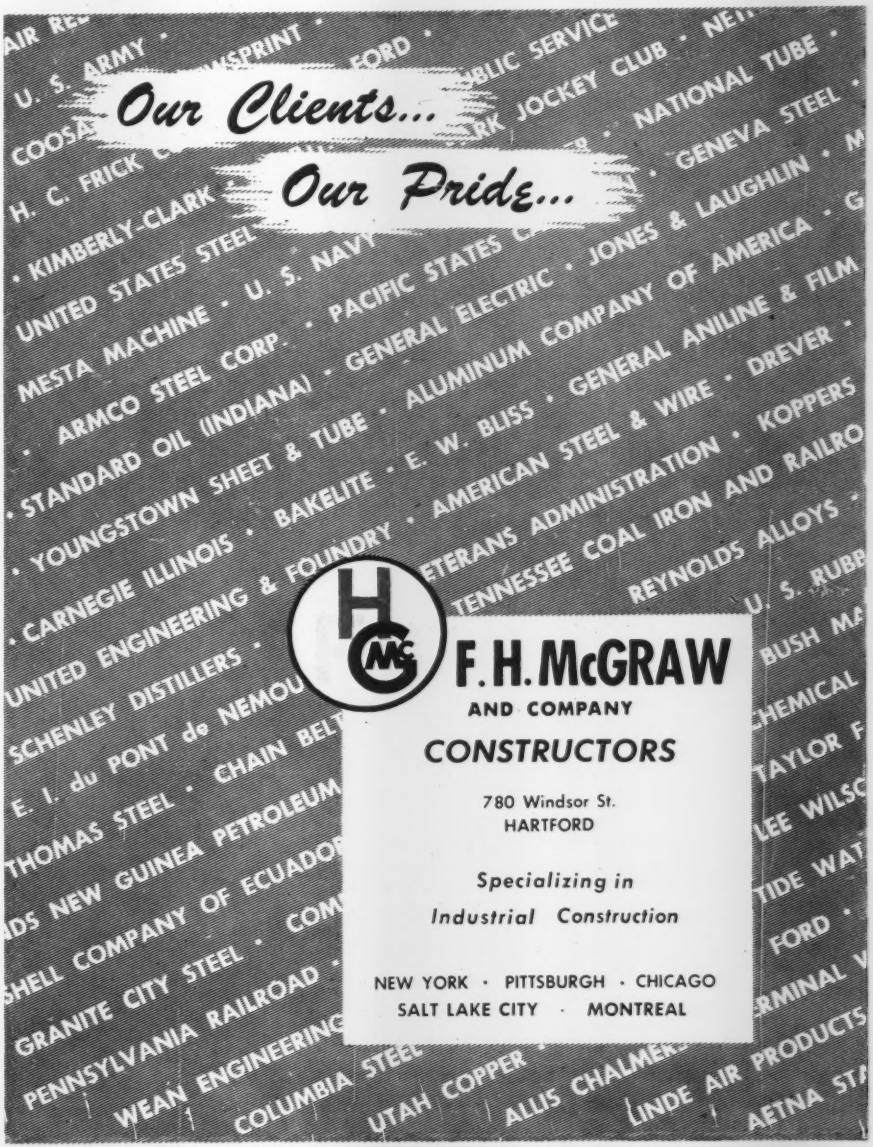
Ask us for complete data. Armco Drainage & Metal Products, Inc., 1871 Curtis St., Middletown, Ohio. Subsidiary of Armco Steel Corporation.

Export: The Armco International Corporation

Armco Drainage Structures

ARMCO

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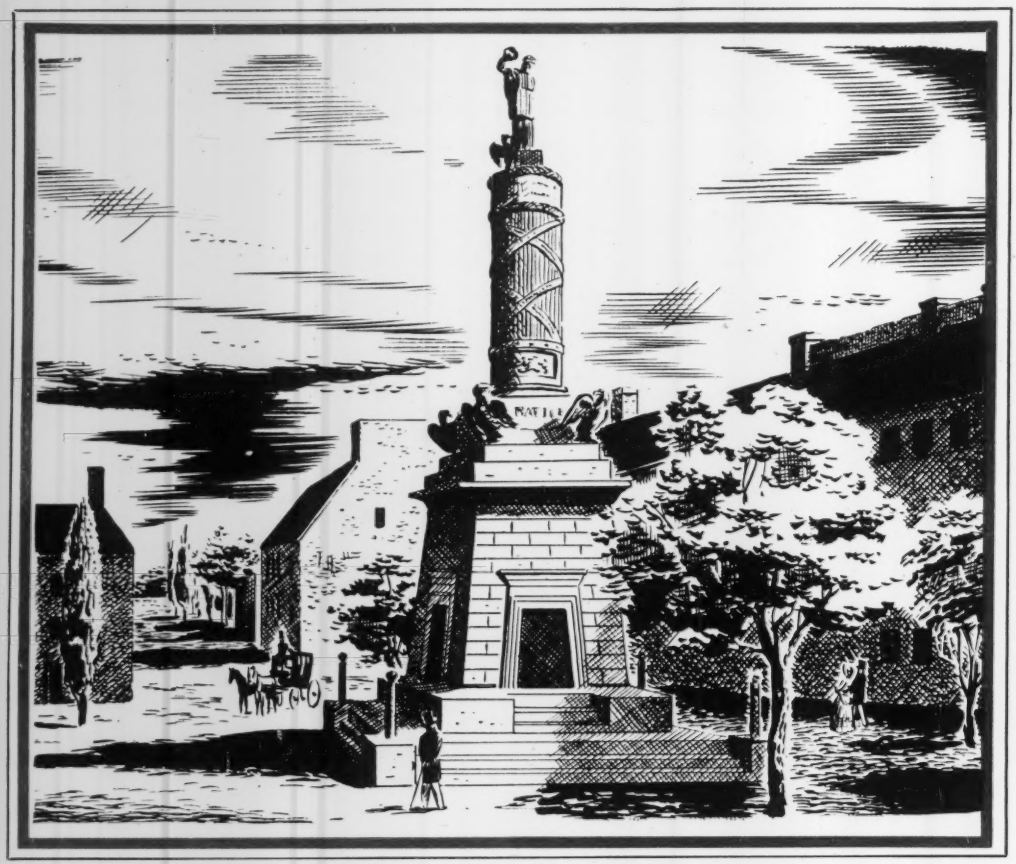

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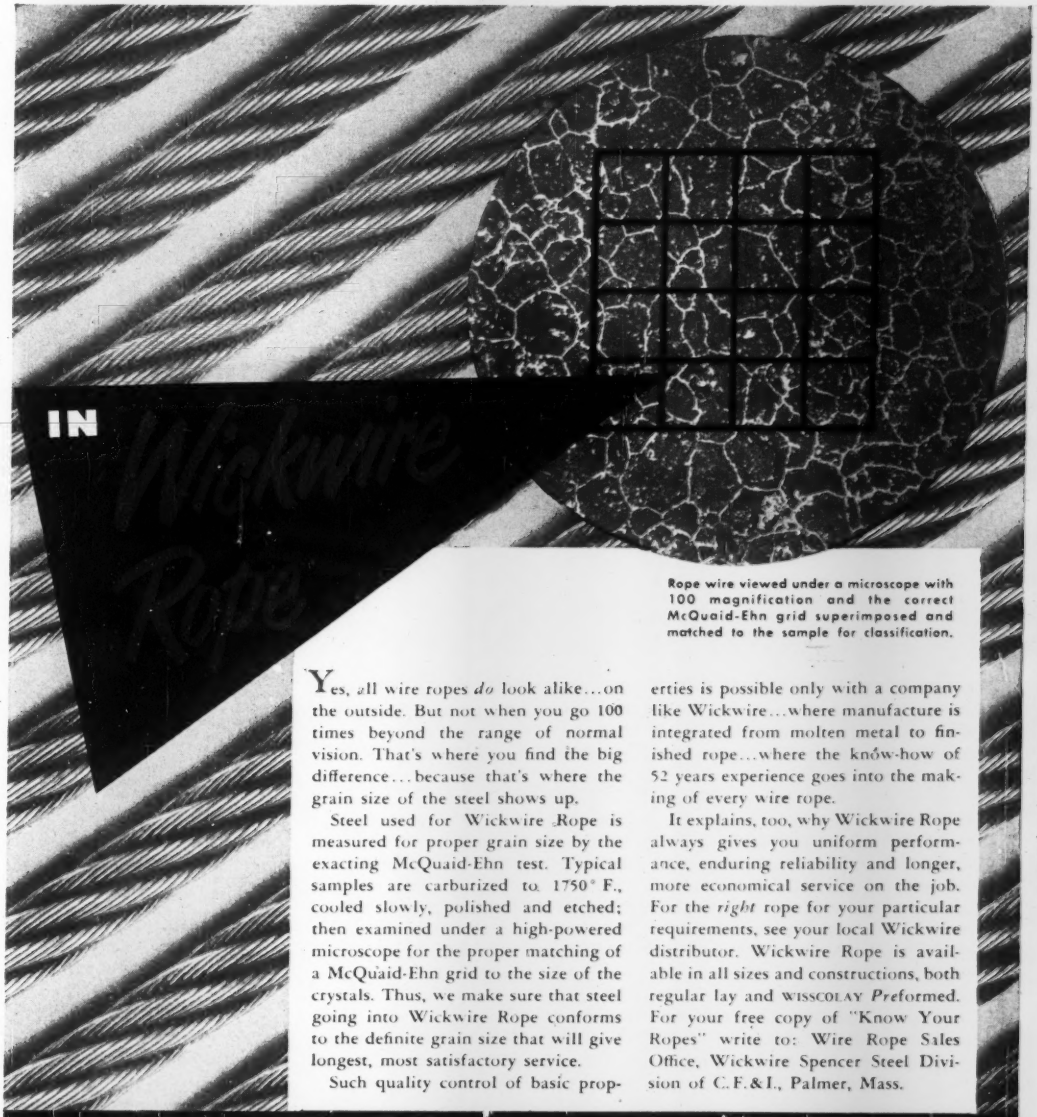

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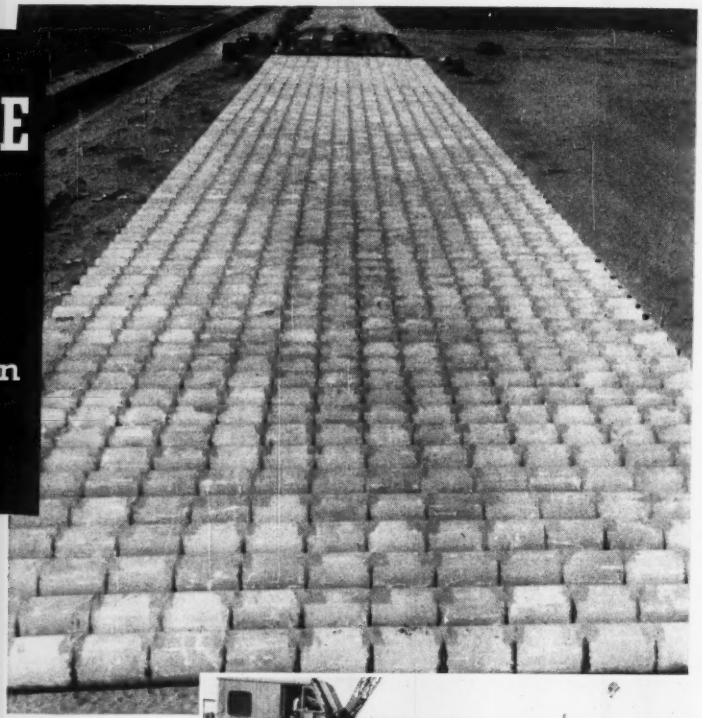

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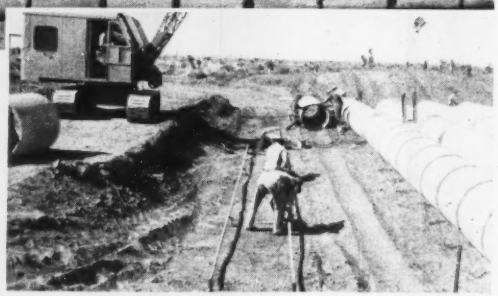

Top photo shows extent of installation before backfilling. Photo above shows (1) pipe runners used to carry circle screed, (2) cradle in sand formed by screed, (3) installed pipe lines. Photo below shows backfilling operation.

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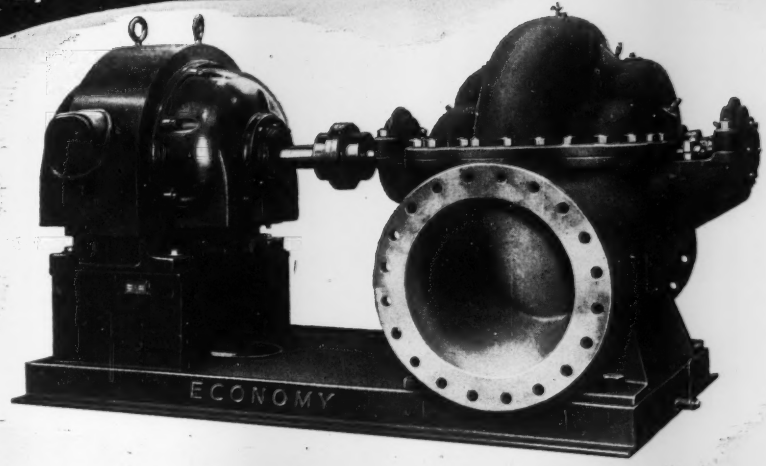

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deep water or swamp—

NO PROBLEM FOR MONOTUBE

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BRIDGE foundations often pose tough problems. No exception was the construction of the 900-foot trestle-type bridge across the Tuckahoe River on Maryland State Route 328.

Here, engineers faced a 3-way foundation problem: deep water . . . swamp areas with soft layers of aluvial mud . . . and the need for a full 18-foot clearance above mean tide in the channel area. Careful studies proved Monotube tapered steel piles to be both the ideal *and* the lowest-cost solution to an unusual problem.

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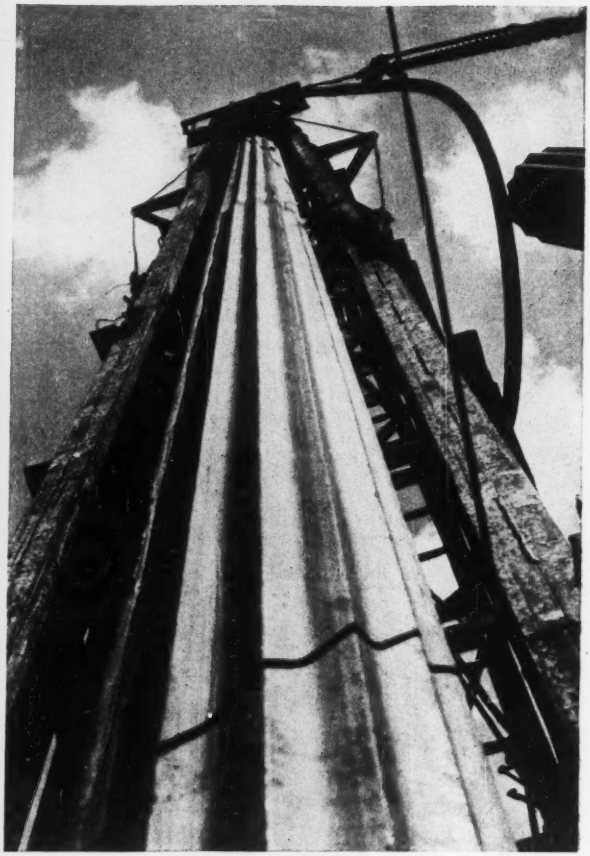
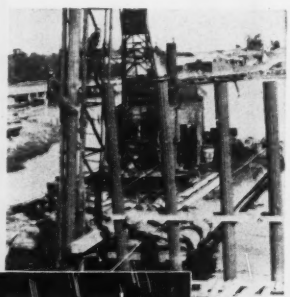
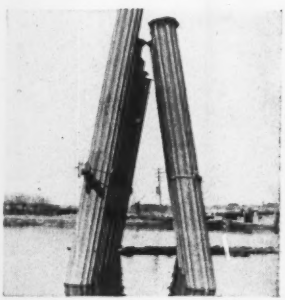


Looking at 65 feet of Monotube pile straight up from the water. Approximately 10,000 feet of 7 gauge and 3 gauge piles were used for the Tuckahoe River bridge, built for Maryland State Roads Commission by Tidewater Construction Company, under direction of Walter C. Hopkins, Deputy Chief Engineer.





Left: Welding extensions to tapered portion . . . a big time-saving.

Right: Twelve Monotube piles driven for a double bent . . . strong, rigid, good for years.

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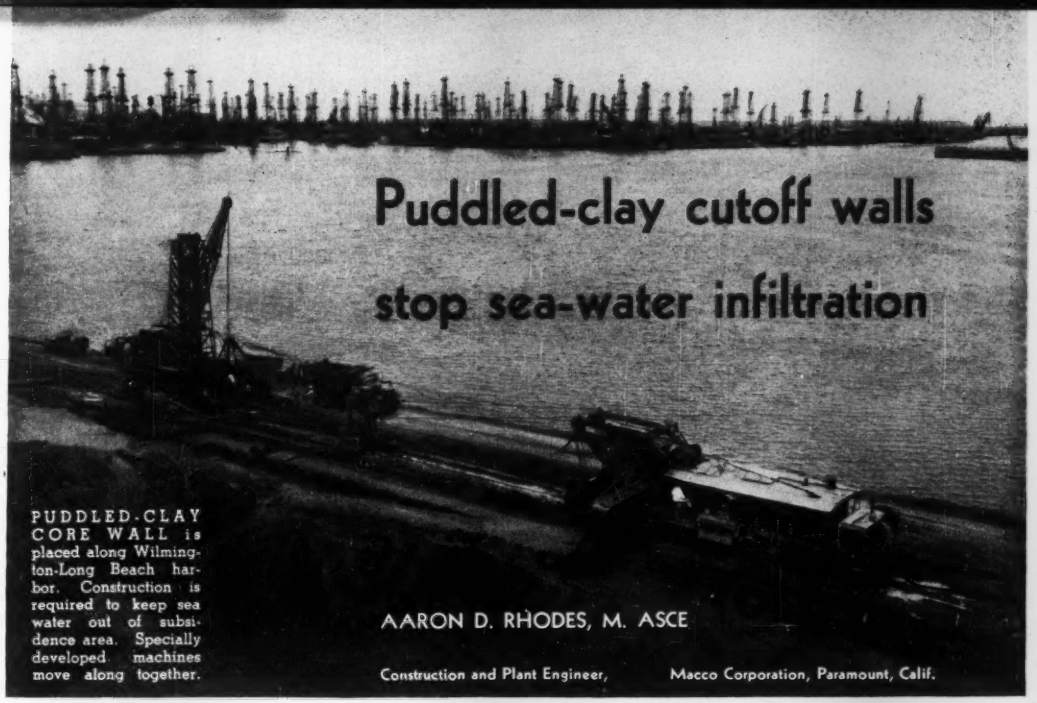
Monotube Foundation Piles



Puddled-clay cutoff walls stop sea-water infiltration

PUDDLED-CLAY CORE WALL is placed along Wilmington-Long Beach harbor. Construction is required to keep sea water out of subsidence area. Specially developed machines move along together.

AARON D. RHODES, M. ASCE

Construction and Plant Engineer, Macco Corporation, Paramount, Calif.

USE OF puddled-clay cutoff walls is the latest method developed to prevent encroachment of the sea into the subsidence basin of the Wilmington and Long Beach, Calif., harbor areas. In these areas for a number of years the subsurface strata have been settling at rates that threaten the inundation of valuable lands and developed properties. Here oil wells, producing facilities, steam-electric generating plants, factories and shipyards will sink into a watery grave unless immense protective works are undertaken soon. See articles in CIVIL ENGINEERING by Commander Lewis C. Coxe (November 1949, p. 44), W. L. Chadwick (June 1950, p. 17), and R. Howard Annin (June 1950, p. 20).

Puddled-clay cutoff walls heretofore have been constructed in fairly dry locations but in the project under discussion, the tides of the Pacific Ocean rise very close to the surface of the lands to be protected. In some places, the only deterrent to complete inundation at high tide was low dikes which were not immune to percolation. In other places channeled dikes permitted streams of water to come through, which with seepage through the subsoil made vast areas unusable. Under these conditions, clay cutoff walls could not be built by the usual methods.

One of the major oil producers has large holdings in the Wilmington and Terminal Island fields which border harbor channels in the heart of the subsidence area. After much consideration and an extensive subsurface investigation by O. J. Porter & Co., consulting soil engineers, it was determined to surround this oil field on the ocean side by a levee high enough to protect the property for several years to come. Incorporated in this levee is a central core of puddled clay extending deep enough to tie in with impervious clay strata. This construction will prevent serious underground seepage and allow the low lands inside to gradually dry out. The elevations of the impervious strata were predetermined by core-drill sampling under the direction of the soil experts. Hydraulic dredge fill, composed of sand and silt, covers the clay strata and carries sea water at levels varying with the tides. Under these conditions any usual open-trench method for placing a suitable clay core wall would be totally impossible.

After the soil investigation had been completed, the preliminary design of the levee construction prepared, and a tentative alignment selected, Macco Corporation was engaged to construct the project. The author was selected to develop methods, procedures and suitable equipment.

It was soon evident that successful accomplishment of the project required the use of a slurry similar to that used by oil-well drillers to maintain open well holes at all depths and in all types of formations. During the experimental period, 1,800 lin ft of clay core wall was constructed to depths of 15 to 25 ft. The sections of accepted clay core wall later placed, totaling 11,895 ft, are listed in Table I. In all cases the core-wall trench was 32 in. wide. The depths listed in the table were those required to tie the core wall in with underlying impervious strata as determined by core drilling. Several thousand lineal feet more of core wall are now under construction.

Construction Equipment and Methods

Exhaustive experimental work indicated the advantages of using a large ladder-type trenching machine. Accordingly a machine was rebuilt to meet the requirements of trenching to depths up to 45 ft. To dig the 32-in.-wide trench, specially designed buckets, of the closed clamshell type, were fabricated from alloy plate steel. These buckets open to discharge the spoil as they pass over the head-shaft sprockets.

The ladder structure is of a sectionalized latticed construction permitting the use of a length suitable to the best operating conditions, fabricated with special alloy steel of high strength to allow for lighter weights and the extreme length necessary (78 ft from

LADDER TRENCHING MACHINE cuts 32-in. trench deep enough to connect with impervious clay strata 20 to 45 ft below surface. Banks of sandy material are maintained by keeping trench full of slurry. Ram on backfilling machine pushes clay down to full depth of trench, displacing slurry as machine progresses.

center of head shaft to tail pulley on the deepest ditch).

The links and pins of the digging chain are made of alloy steel so that they will stand up at the great depths involved, in an abrasive fluid which closely resembles valve grinding compound. Because of the submerged operation, no idlers were used. Instead, channel guides with renewable sole plates were built into the ladder.

To decrease the cutting drag, the buckets were provided with stagger-mounted replaceable forged cutting teeth, as the use of a solid cutting lip in experimental runs did not materially reduce the amount of suspended solids in the trench slurry but did greatly increase power requirements.

The trench walls are maintained by keeping the ditch filled with slurry, to within 1 ft above or below berm. The slurry consists of water, clay, and gel (bentonite) and its characteristics are carefully controlled. Its average characteristics are: weight, 67 lb per cu ft; viscosity 43.6 (marsh); water loss, 5.5 cc in 30 min; initial shear, 0 to 3 lb per 100 sq ft; 10-min shear, 8 to 10 lb per 100 sq ft. These characteristics can be obtained only by using a high-grade light-weight oil-well drilling mud and bentonite, thoroughly mixed and hydrated.

This slurry was delivered from a centrally located mixing plant by trucks which constantly pumped their loads into the trench. The slurry was maintained in condition by discharging a part with the spoil to one side of the berm and circulating upwards of 800 gpm through a Corwin Desander, which discharged into the ditch several feet behind the digging position. Sandy waste was conveyed to the spoil bank. Fresh water was added in controlled amounts so that the following average qualities are obtained in the trench slurry: weight per cu ft, 76.3 lb; viscosity 52 (marsh); 15.6 percent sand by elutriation.

Placing the Clay Backfill

Clay backfill was placed in the trench by a specially designed machine developed during the experimental procedures previously referred to. This machine consists of a puddling ram that is constantly raised and lowered the full depth of the trench immediately in front of a feed hopper provided with a manually operated gate adjusted according to the varying requirements of trench depth and the changing moisture content of the backfill material. The flow of the special-quality clay used for backfill is very susceptible to small changes in moisture content.

The hopper on the backfill machine is open for its full length and the puddling ram continuously forces the dry backfill material down so that minimum angle of repose of 2:1 is maintained ahead of the backfilling machine. The clay continuously displaces the wet slurry as the machine progresses.

The backfill hopper is fed with a truck crane using a 1-cu yd clamshell bucket and dragging a truck dump hopper. The truck crane moves along beside the backfilling machine.

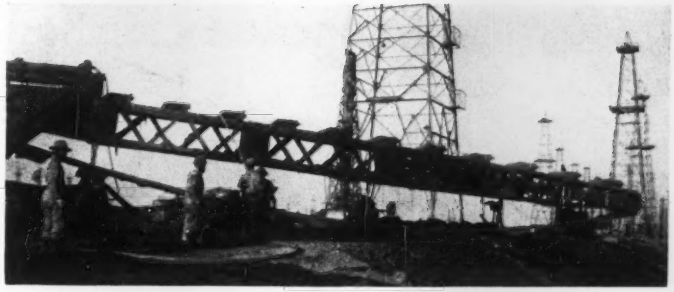
The clay backfill is mined in the California desert, near Baker, and transported by railroad to an undertrack hopper discharging into dump trucks which in turn supply the truck dump hopper on the truck crane.

The trencher is equipped with a gasoline motor which supplies its own motive power and operates the trenching buckets. This power also pulls the desander and the backfiller, which are attached to the trencher by cables so that all three move along together at a fixed spacing. This spacing is determined by the depth of the trench being cut.

In addition to its regular motor, the trencher carries a diesel-electric generator, mounted on the front end, which supplies the electric power for the other units. This power is transmitted to the other units by cable. The generator also acts as a counterbalance for the extra weight of the out-size digging ladder.

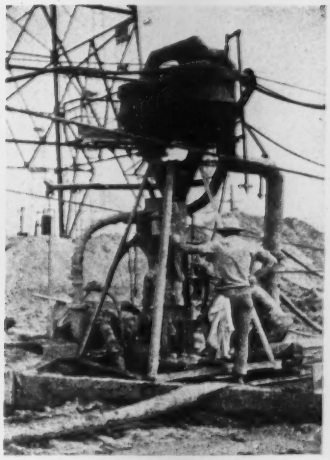
Considerable lengths of trench were cut through fills which had been built up in stages as the subsidence progressed. A variety of obstructions were encountered, such as piling, fences, timbers, and concrete. Whenever an obstruction was encountered that could not be removed with the digging buckets, the ladder was raised sufficiently to pass over it, and at a later date these sections were removed by driving a cofferdam, excavating by conventional methods, removing the foreign material, replacing the clay core wall and pulling the cofferdam box to insure continuity of the core wall.

Over 200 cores per mile were taken through the completed levee. They showed a continuous clay wall from the top of the levee to the clay sub-



LADDER on trenching machine is 78 ft long, has special clamshell buckets mounted on digging chain. (See facing page and above.) Moving parts are made of alloy steel to resist abrasive action of slurry.

CORWIN DESANDER and electric slurry pump (top right) partially remove sand from trench slurry as excavated material becomes suspended in it.



strata which had been selected as a bed. In addition to the cores, an elaborate examination was made at several locations by driving a cofferdam box and excavating to the full depth of the trench, and then dewatering. This investigation showed that the clay wall had uniform sides, was entirely free of sand inclusions or lenses, and was intimately seated on the selected bed material. Also, elaborate test set-ups were prepared by using well points to enclose selected sections on the landward side of the completed core wall. Piezometer readings taken in these sections to determine the seepage proved that the sea had been completely shut out.

Future Possibilities of Trenching Method

While it does not seem likely that the equipment here described can place puddled-clay cutoffs much deeper than 45 ft, preliminary studies indicate that much greater depths could be dug and placed economically where the volume of work was sufficient to justify the expense of developing the necessary equipment.

The work here described was performed by contract with the Union Pacific Railway Co. on its properties under the direction of Gene Cox, Petroleum Engineer, in charge of inspection and testing. The equipment was developed, experimental work accomplished and the entire project completed by Macco Corporation, General Construction Division, with John M. Sawyer, M. ASCE, as General Superintendent. The author as project engineer conducted the experimental work, designed the machinery described, and developed the methods and procedures used.

O. J. Porter and Co., under the direction of William Jervis, M. ASCE, made the preliminary survey and soil analyses, took the necessary cores, and made the exhaustive engineering study which formed the basis for the work.

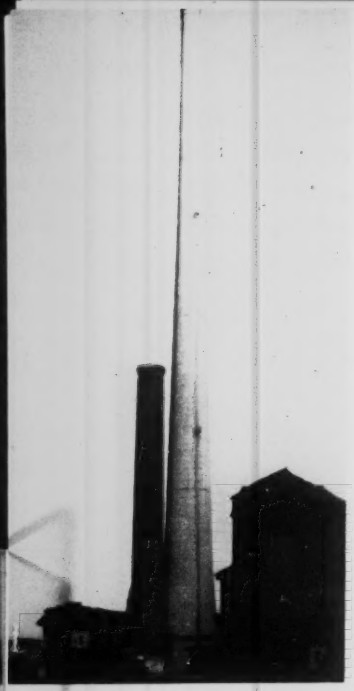
CLAY for trench backfill is picked up from dumping platform by crane bucket for loading into hopper of backfilling machine. Truck crane, which pulls dumping platform, runs along beside backfilling machine.

BACKFILLER, here seen from rear, carries puddling ram for trench 45 ft deep. Crane at right loads hopper over trench from dumping platform which is drawn behind crane. Note crown of clay over trench.

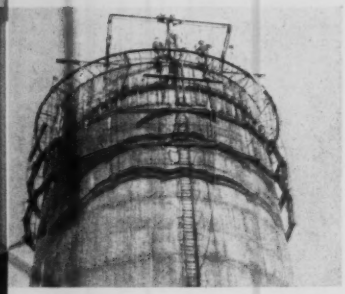
TABLE 1. PUDDLED-CLAY CORE-WALL SECTIONS CONSTRUCTED TO OCTOBER 20, 1950

Section	Length, Lin Ft	Depth, Ft	Spoil, Cu Yd	Dry Clay Backfill Placed			
				Tons	Tons per Lin Ft	Vol, Cu Ft	Backfill, % of
A	1,534	18	73,600	2,910	1.9	72,100	98
B	309	25	20,500	805	2.0	20,000	97.6
C	1,167	20	62,500	2,636	2.25	65,500	104.4
D	2,592	25	172,300	6,506	2.52	161,500	93.8
E	635	20	3,390	1,293	2.04	3,220	94.9
F	1,366	25	91,200	3,282	2.40	81,500	89.4
G	948	32	81,000	3,063	3.23	76,500	94.2
H	790	23	48,500	1,785	2.26	44,300	91.4
I	978	33	86,100	3,021	3.09	75,200	87.3
J	320	30	25,630	850	2.67	22,700	89.0
K	246	35	22,990	724	2.95	19,350	85.0
L	520	45	62,480	1,732	3.34	46,200	75.0
M	82	40	8,760	246	3.01	6,580	75.0
N	408	38	41,400	1,266	3.10	33,900	82.0

Reinforced concrete chimney



COMPLETED CHIMNEY towers above old 250-ft brick chimney at El Paso, Tex., lead refining plant of American Smelting and Refining Co. New structure has dual purpose of providing better draft and minimizing nuisance under unfavorable atmospheric conditions.



TWO LEVELS of scaffolding are suspended from forms to provide for form adjustment and concrete finishing. Ladder steps and guard rungs are built into concrete.

VERTICAL reinforcing bars overlap so that half of bars end lap distance above top of pour (below).

THE WORLD'S tallest chimney was completed in El Paso in October 1950, giving the State of Texas another first to add to its imposing list. Located at the El Paso plant of the American Smelting and Refining Co., this reinforced concrete chimney is 611 ft high above the top of its foundation, and has an internal top diameter of 14 ft 0 in. The chimney is used to discharge the gases from six Dwight & Lloyd sintering machines used in the refining of lead ore. It replaces the smaller common-brick chimney seen beside it at upper left.

Between the sintering machines and the chimney the gases pass through a spray chamber and a large bag house which removes most of the solids. The function of the spray chamber is to reduce the gas temperature to below 200 deg F so that the woolen bags will not be damaged. The tall chimney was required to provide sufficient draft on the bag house, which heretofore had been lacking. Also the height of the chimney greatly minimizes any chance that the gases, which contain approximately $\frac{1}{2}$ of 1 percent of sulfur dioxide, will become a nuisance under unfavorable atmospheric conditions.

Standard Specifications Followed

The specifications called for the chimney shaft to be designed in accordance with Specification 705-36T of the American Concrete Institute titled "Tentative Specification for the Design and Construction of Reinforced Concrete Chimneys," which has been the basis for the design of practically all large reinforced concrete chimneys built in North America in the past 15 years. For design purposes, the wind force on the chimney was specified as a uniform pressure of 33 psf on the entire vertical projection. A maximum gas temperature of 300 deg F and minimum atmospheric temperature of 30 deg F were specified as design criteria, although under average operating conditions, gas from the bag house is discharged into the chimney at approximately 180 deg F.

In order not to exceed the allowable stresses set forth in the design specification, it was necessary to specify that the concrete develop a 28-day ultimate compressive strength of 3,500 psi in the lower 330 ft of the chimney, and 3,000 psi in the remainder of the chimney. In accordance with the specifications, cylinder tests of representative concrete samples were made as the job progressed, with the results shown in Fig. 1. At no time did the 28-day strength fall below 4,000 psi, an indication of the contractor's conservative design and careful control of the mix.

The specifications called for the cement, aggregates and reinforcing steel to conform to the latest ASTM requirements, and required 3 lb of Johns-Manville Cellite to be added as an admixture to each bag of cement. As the gases passing through the chimney are fairly cool and not highly corrosive, a masonry lining was not specified. The interior of the chimney, however, was painted with a special coal tar paint to protect the concrete from possible attack by corrosive constituents of the gas.

Foundation on Very Hard Gravel

A study of the subsoil conditions at the site indicated that the bottom of the foundation should be 13 ft below the present grade. At this level very hard gravel is encountered, and loading tests indicated a design soil loading of 8,500 psf. The reinforced concrete foundation was designed in accordance with Specification 318-47 of the American Concrete Institute, titled "Building Code Requirements for Reinforced Concrete." The 28-day compressive strength of the foundation concrete was specified as 2,500 psi. The foundation is 8 ft 0 in. thick, of which the lower 2 ft 6 in. is an octagonal slab 66 ft 6 in. wide across the flats, and the remaining 5 ft 6 in. slopes inward to an octagon measuring 46 ft 0 in. across the flats at the top. Adequate reinforcing steel was provided at top and bottom. The foundation required 2,040 cu yd of excavation, 880 cu yd of concrete, 38 tons of reinforcing steel, and 875 cu yd of backfill. The difference of 285 cu yd between the volume of the excavation and the sum of the volumes of the foundation and the backfill repre-

built to record height of 611 ft

ARTHUR M. CLARK, Jun. M. ASCE, Assistant Engineer,
Custodis Construction Co., Inc., New York, N. Y.

sents the volume occupied by the lower 5 ft of the chimney, which is below the finished grade.

The chimney shaft, starting at the top of the foundation, is 611 ft high, or 606 ft above grade. The shaft is tapered from top to bottom, the increment of increase in the outside diameter varying from $2^5/_8$ in. per 10 ft of vertical height in the upper part to $8^5/_8$ in. per 10 ft of vertical height at the bottom. The bottom outside diameter is 44 ft 10 in. Wall thicknesses at the top and bottom are 9 in. and 25 in. respectively. At the extreme top, the wall is offset 3 in. on the outside, and the maximum wall thickness is 27 in. at the bottom of the flue opening, where additional wall thickness and extra reinforcing steel are required to compensate for the opening.

Vertical reinforcing, designed for the combined effect of dead load, wind load, and vertical temperature effect, increases from fifty $^1/_2$-in. round bars at the top, to two hundred and two 1-in. round bars at the bottom of the shaft. The horizontal reinforcing, designed for diagonal tension and horizontal temperature effects, consists of $^3/_4$-in. round bars spaced 6 in. on centers directly above and below the flue opening; $^5/_8$-in. round bars spaced 6 in. on centers between the top of the foundation and the flue opening, and also for the height of the opening itself; and $^1/_2$-in. round bars spaced 6 in. on centers for the remainder of the shaft. The chimney shaft contains 2,394 cu yd of concrete and 142 tons of reinforcing steel, and its dead weight above the foundation is 4,885 tons.

Tests made to determine the mix for the several concrete strengths produced the following data:

28-Day Strength, psi	Ratio of Cement to Aggregates by Volume	Water Cement Ratio, Gal per Bag of Cement
3,500	1:4.52	$5^1/_2$
3,000	1:5.02	6
2,500	1:5.90	$6^3/_4$

Sand and coarse aggregate were obtained locally, and the cement came from the El Paso mill of the Southwestern Portland Cement Co.

Construction work on the foundation commenced October 19, 1949, and was completed November 25. Usual construction methods were employed in building the foundation and the concrete was placed in a continuous pour consuming $3^1/_2$ days. Construction of the chimney shaft started March 12, 1950, and the shaft reached its final height of 611 ft on September 21. All incidental work was completed, and the chimney accepted by the owner on October 20, 1950.

Adjustable Steel Forms Used

In constructing the shaft, the contractor used his standard adjustable steel chimney forms with a hanging derrick and working platforms. These forms permit pouring 10 ft per lift. New forms were used which were provided with foam rubber strips at the bottom to prevent loss of water at the start of a pour. Concrete was mixed in two batch mixers located at each end of an elevated bin batcher, which in turn was charged by a portable conveyor. All materials were mixed a minimum of $1^1/_2$ min. The average slump of the concrete was 5 in.

From the mixers the concrete was conveyed by chutes to the center of the chimney and hoisted up inside the chimney to the working platform in a specially designed bucket. On the working platform the concrete was conveyed into the forms by chutes and vibrated. The exterior surface of the concrete was water cured for a period of ten days after pouring by a water spray encircling the chimney and located directly below the forms and moving with them.

There is an outside ladder from the bottom to the top of the chimney which consists of $^3/_4$-in.-dia safety-tread rungs 16 in. wide embedded in the concrete wall. Ladder steps are spaced vertically on 15-in. centers which is customary practice. The safety cage which surrounds the ladder for its full height consists of $^3/_4$-in.-dia guard rungs spaced on 3-ft 9-in. centers and tied with U-bolts to three $2\times{}^1/_4$-in. vertical straps forming the cage. Rest platforms are provided at the 200 and 400-ft levels. The ladder, safety cage and rest platforms were fabricated from wrought iron. Four wrought-iron scaffold bands, equipped with hanger loops to provide access to any point on the exterior of the chimney, were installed at 150-ft intervals.

Lightning-Rod System Provided

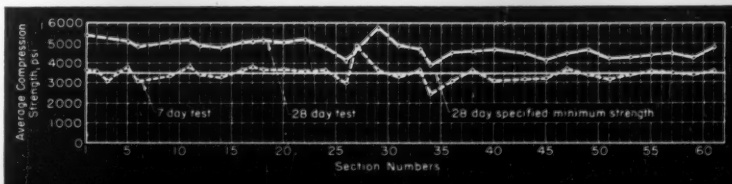
The lightning-rod system consists of four points spaced at equal intervals around the periphery of the top, two down-leading cables, and interconnected encircling cables at the top, midpoint and bottom of the chimney. The points are $^3/_4$-in. solid copper rods and the cable is $^5/_8$-in heavy stranded copper cable. Each down-lead has its own grounding system consisting of three copper-covered grounding rods of $^3/_4$-in. diameter, driven into the ground 10 ft. These rods are arranged in the form of a triangle with sides 10 ft long and they are connected below the ground with $^5/_8$-in. copper cable.

The extreme top of the chimney is protected by a sectional cast-iron cap having a minimum material thickness of $^5/_8$ in. The sections of the cap are bolted together with stainless steel bolts, and the cap is electrically connected to the lightning protection system. Bronze inserts are provided around the 10-ft-wide by 21-ft-high flue opening to permit attachment of the steel breeching from the bag house. Access to the bottom of the chimney is provided by a 2×3-ft cast-iron door at grade.

At average operating conditions of 180 deg F gas temperature and 60 deg F atmospheric temperature, the chimney provides a theoretical draft of 1.05 in. water at the flue dampers and has a capacity of 285,000 cu ft of gas per min.

The chimney was designed and built by the Custodis Construction Co., Inc., of New York and Chicago, designers and builders of industrial chimneys for the past 52 years, of which F. Barnard O'Connor, Assoc. M. ASCE, is president and general manager.

FIG. 1. COMPRESSIVE tests of chimney concrete made in accordance with specifications showed that 28-day strength never fell below 4,000 psi, though specified minimum was 3,500. Each section represents 10 ft of vertical height of chimney.



Power systems of Southwest benefit from improved interconnections

N. B. HINSON, Vice-President, Southern California Edison Co., Los Angeles, Calif.

THE TREND toward interconnecting the power systems of the Southwest has been encouraged both by local conditions and by world events. The result of these interconnections has been a great saving in capital and operating costs as well as additional protection for industry and the public throughout the area.

A brief review of past developments in the power industry in California and contiguous areas will be helpful to an understanding of the present situation. Early electrical development in California started much as it did in other parts of the United States—with small steam plants. As there was no coal in the area and other fuel was scarce and high priced, and the steam generating equipment was of very low efficiency compared to that of modern steam turbines, the early operators turned to hydroelectric development on the nearby mountain streams. Most of the plants were small and scattered, and as the systems grew the steam and hydro resources were grouped to supplement each other. To obtain more hydro power it became necessary to go farther and farther back into the mountains, and this factor, coupled with the fuel situation, was responsible for much of the pioneering work in hydroelectric development and long-distance transmission in California.

Large Systems Come Into Existence

Consolidations continued as the systems expanded. By the end of the first World War there were two large systems in the San Francisco Bay area, two in the San Joaquin Valley, four in the Los Angeles area, one in San Diego, and one in the San Bernardino area, all of which were 60 cycles except three at 50 cycles in the Los Angeles area. There were no real interconnections as we think of them today. There were, however, some ties of very limited capacity, several by means of frequency changers.

The dry year of 1924 called attention to what the systems could do in helping each other. There were a few interconnections of limited capacity between the 50- and 60-cycle systems in the San Joaquin Valley and in the Los Angeles area. The City of Los Angeles and Edison operated in parallel at 50 cycles. To make additional energy available during the heavy summer irrigation load, the 60-cycle generators of the Los Angeles Gas and Electric system were operated at 50 cycles on the Edison system. All available steam plants, including some that had been shut down for years, were brought into service. The situation was doubly difficult because the drought limited the amount of water available for hydro generation and also increased the demand for power for pumping irrigation water. The total amount of power involved was small by today's standards but was very vital.

Construction of the Boulder Canyon Project started a new series of events. The cities of Los Angeles, Pasadena, Glendale, and Burbank converted their 50-cycle systems to 60 cycles, which made it necessary to install larger frequency changers. The additional capacity from the Hoover Power Plant temporarily released certain generating capacity in Southern California for use in other areas. To transport this power the first substantial interconnections between the northern and southern parts of the state were made. The difference in frequency was still a barrier, but as the Edison Company system in the San Joaquin Valley had always been 60 cycles and was supplied by frequency changers from the 50-cycle system and by direct generation at 60 cycles, it was possible to transfer energy from south to north by operating 50-cycle generators in the Big Creek plants at 60 cycles.

Larger interconnections were also made from the Los Angeles area to San Diego at this time. Early experience in transmitting large blocks of power long distances at high voltage was very helpful in making these new interconnections.

At the start of World War II, much of the new generating program in California was deferred, yet the war increased the loads. To meet this situation, the Pacific Southwest Power Interchange Committee was created in the early part of 1942 to make load and resource studies of the whole area and to investigate the problem of how to make the maximum use of the facilities available. The Committee is a voluntary organization which acts in a cooperative and advisory manner. Its membership includes representatives of municipalities, utility districts, private utilities, and state and federal bodies. There is no area-wide contractual obligation for parallel operation and exchange of energy, but there are interchange agreements between individual systems. Excellent cooperation in coordinating overhaul schedules, sharing reserves and providing assistance during emergencies has been obtained between individual systems through the Interchange Committee.

Arizona and Parts of Nevada Added

As far as interchange of power and pooling of resources was concerned, Arizona was added to the California area and those parts of Nevada electrically connected with California were also included. Certain of the interconnections were increased in capacity, and the amount of additional energy made available to the whole area by pooling of resources and interchange of energy and capacity was one of the major contributions of the electrical industry in this area to the war effort.

After the war the Southern California Edison Company started conversion of its 50-cycle system to 60 cycles. Since completion of this work in October 1948, all the systems in California operate at the standard frequency of 60 cycles, so that high-voltage transmission lines can be connected direct. All frequency changers have been removed and are now used as synchronous condensers. A small section in Arizona still operates at 25 cycles and is interconnected through frequency changers to the 60-cycle system.

Lack of rainfall in the early part of 1948 again demonstrated the benefit of interconnections as it was possible

to transfer as much as 200,000 kw from one major area to another.

Studies are now under way to increase the capacity of the interconnections between northern and southern California by interconnecting the 220-kv lines of the Pacific Gas and Electric Company in the north with those of the Edison Company crossing the San Joaquin Valley and feeding to the south. Plans are also under way for increasing the capacity of the interconnection between the 132-kv system of the Department of Water and Power and Edison's 220-kv system in the Los Angeles metropolitan area.

There are 66-kv and 115-kv direct ties from the Edison system to the San Diego Gas and Electric Company and 66-kv ties from Edison to California Electric Power Company. The City of Los Angeles has direct 33-kv ties with the steam generating plants of the cities of Pasadena, Glendale, and Burbank, and a 115-kv tie with the California Electric Power Company. The Metropolitan Water District and the Edison Company jointly use generators at Hoover and the transmission line from Hoover to Hayfield. This line ties into the Parker Power Plant on the Colorado River and is interconnected there with the 161-kv system of the Bureau of Reclamation supplying Arizona.

Thus since October 1948, it has been possible when necessary to operate all utilities in California in parallel as well as those in Arizona and parts of Nevada. Such operation is not practiced continuously as it creates some operating problems, and usually only parts are in parallel.

Normally, a large electric system regulates its own frequency and time when it operates in parallel with another system. The smaller systems, which normally operate in parallel with a large system, control the load on the tie line manually. In practically all cases there is a direct tie between the large and smaller system, and where the distances are great, telemetering is extended to the dispatching center of the generating plant. With relatively simple interconnections between small systems and a large one, manual regulation is satisfactory. When the larger systems operate in parallel, one system regulates time and frequency and the other systems coordinate their load control with the regulating system.

Need for Automatic Tie-Line Load Control

With uniform frequency and direct transmission, manual regulation between large systems is not too satisfactory. The installation of telemetering between the tie lines and the system dispatchers improves the situation, but is inadequate as it still requires manual control of the load. The first automatic tie-line load control in the area was installed on the 220-kv interconnections between the Edison Company and the Metropolitan Water District system. At present the Edison Company and the Pacific Gas and Electric Company are installing such automatic control at all principal points of interconnection with other systems. The Bureau of Reclamation plans to install automatic tie-line load control on the Nevada-Arizona network, and the installation of such control is under discussion by the Los Angeles Department of Water and Power. Most of the proposed systems will include flat frequency, selective frequency, flat tie-line bias and total net interchange control. Telemetering to the dispatcher's headquarters will be included.

With adequate interconnections it is possible to transfer surplus power from one system to another, to make use of the most efficient generating capacity available in the area, to supply generating capacity and energy in emergencies, and to take on additional loads quickly.

The reserves necessary to protect the load are reduced because of diversity between the various systems. In this area, the December 1949 peak was $5^1/_4$ million kilowatts and the difference between the coincident peak and the sum of the non-coincident peaks was over 300,000 kw. These figures give some indication of the saving in capacity, or additional reserves, which can be realized by maximum use of interconnections.

Still greater use can be made of interconnections between major systems when the new interconnections at major transmission voltage are established and automatic tie-line load controls are in service. The result will be a saving in investment and operation as well as additional protection for the whole Southwest.

(This paper was originally presented before the Power Division at the Los Angeles Spring Meeting of ASCE.)

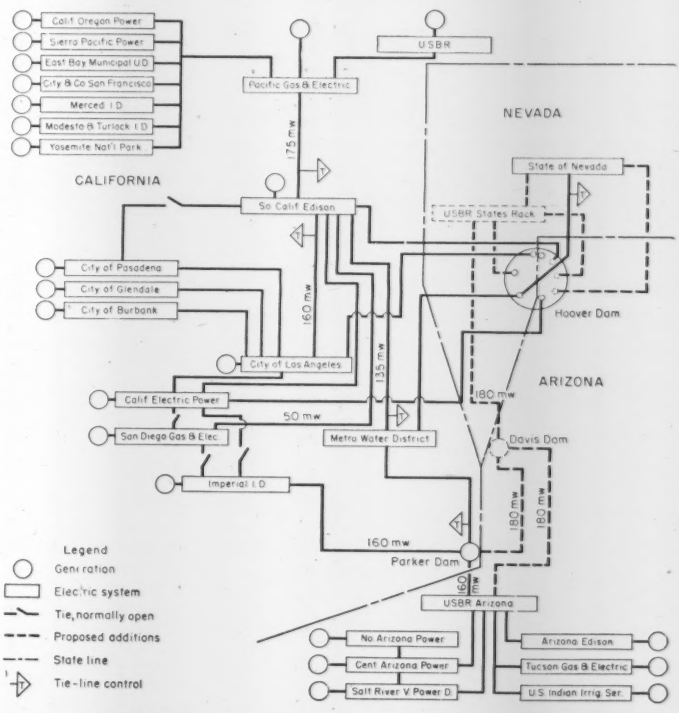
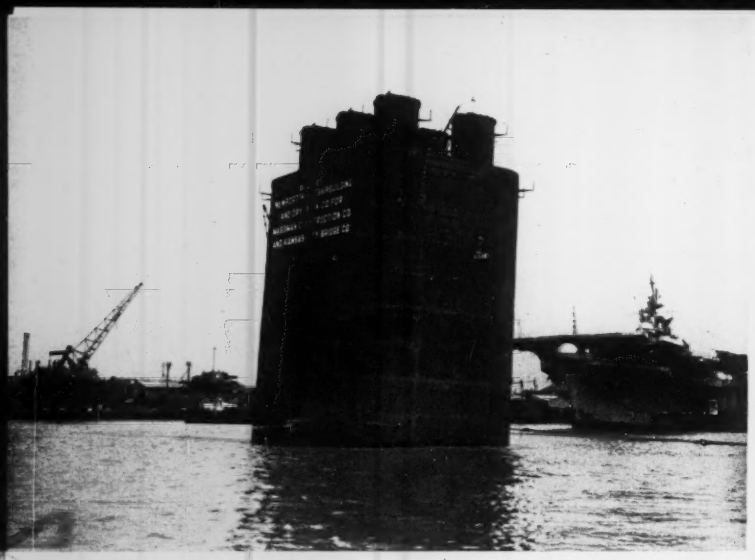


FIG. 1. SCHEMATIC DIAGRAM shows interconnections between electric systems of Pacific Southwest, including Northern and Southern California, Arizona, and Nevada.



CAISSON that has just been launched from dry dock of Newport News Shipbuilding and Dry Dock Co., where it was fabricated, starts 40-mile trip through Chesapeake Bay to bridge site. Draft at launching is about 34 ft, comparable to draft of largest ships afloat. Total height above water is about 80 ft, not counting dredging wells, which extend 16 ft above top. Tow ropes are attached to caisson at each front corner near water line.

MAURICE N. QUADE, M. ASCE, and GEORGE VACCARO, Assoc. M. ASCE

Respectively, Partner and Project Engineer, Parsons, Brinckerhoff, Hall & Macdonald, Engineers, New York, N.Y.

Deep, lightweight piers for bridge at

OPEN-DREDGE CAISSONS of great height were chosen for use in constructing the deep river piers of the George P. Coleman Memorial Bridge at Yorktown, Va. (For location see map on facing page.) This method of construction was chosen to meet the two chief natural factors which controlled the design and construction of the piers—the deep water at the pier sites and the poor bearing character of the underlying strata.

Water depths at the pier sites vary from 50 to 80 ft, and there is a mud bottom from 10 to 40 ft thick. One or more borings taken at each pier site showed that the mud is generally underlain by sand or silt strata some of which contain clay and broken shells in varying amounts. The sand is predominantly fine to very fine. Although most of the piers are founded on these strata, the borings—some sunk to a depth of 220 ft below the water surface—show that the principal material supporting the piers is a medium to stiff clay.

Under these circumstances the tallest pier was designed to have a total height above foundation of 210 ft. This height is made up of a caisson 110 ft deep on which is built a concrete pier shaft about 100 ft high.

Tests showed that the maximum edge bearing for any pier base—including, of course, the overturning effect of all horizontal forces, should be limited to 3.5 tons per sq ft in excess of the existing unit load on a plane through the bottom of the pier base resulting from the present overburden above the plane. Both the resistances to driving the sample spoon and laboratory tests of undisturbed samples obtained from borings led to this conclusion.

Since permanent vertical loads exert more influence on pier settlement than horizontal forces (which are generally of short duration), the net unit bearing on the soil from vertical loads alone was limited to 2.0 tons per sq ft in excess of the bearing pressure from the overburden. The gross vertical load was, however, reduced by the amount of the full buoyancy of that part of the pier below low water and by an allowance of 200 psf for average skin friction on the embedded depth of the caisson base. The allowance for skin friction is equivalent to 0.3 ton per sq ft in bearing on the base.

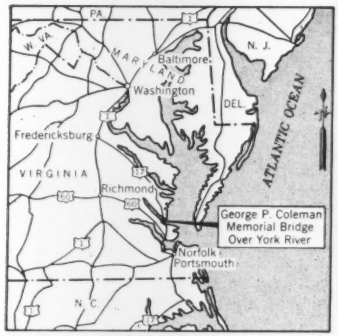
Tallest Pier Is 210 Ft High

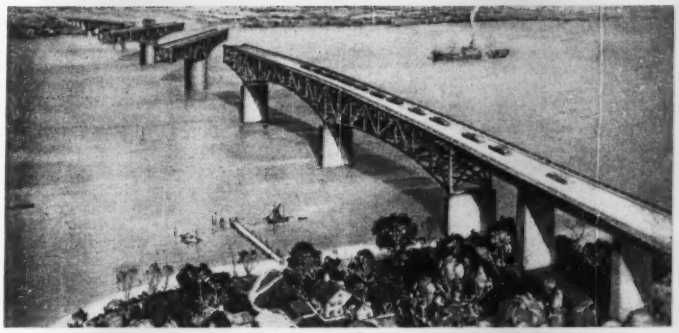
To reach a stratum capable of supporting the net bearing load described above, it is planned to sink piers 1S and 2S to a depth of 150 ft below mean tide level. Piers 1N and 2N will be founded at El. −141 and the two piers nearest the shores, 3S and 3N, at a depth of 135 ft. To identify the piers see Fig. 1.

A rough idea of the problem of limiting the gross bearing pressure to about 4 tons per sq ft may be gained from considering that the tallest pier is 210 ft high and that a 1-ft square column of concrete of that height has a bearing pressure of more that 15 tons per sq ft. Obviously, solid piers of normal stepped and tapered design would not leave much of a margin for supporting the superstructure which, after all, is the only function of a bridge pier.

The pier bases were therefore designed as hollow boxes having exterior walls 4 ft 0 in. thick. One transverse and two longitudinal interior walls—each 3 ft 0 in. thick—divide each base into 6 cells, thereby mutually bracing one another and the exterior walls as well. Even the shafts of the main piers, 1N and 1S, are hollow. Each supports a 500-ft swing span.

To construct such pier bases at the required depth, the open-dredge caisson method was selected. Some of the caissons must be sunk through 80 ft of water and may reach a depth of 110 ft or more before the soil becomes sufficiently firm to support them. Only a steel caisson can be designed to float at that depth. Since a steel caisson is, in reality, a piece of construction equipment, it is usually





TWO 500-FT SWING SPANS in George P. Coleman Memorial Bridge will permit largest warships to ascend York River from Chesapeake Bay. See map above. To reach suitable supporting strata, six river piers will be founded from 135 to 150 ft below mean tide level by means of steel caissons described in this article. Concrete pier shafts and superstructure will then be placed.

Yorktown, Va., built by caisson method

designed by the contractor. Preliminary designs soon indicated that the design and construction of each pier and the design of its caisson were inseparable problems; hence detailed designs for the caissons were included in the contract plans. Basic design criteria for the finished pier were outlined in the specifications, and bidders were permitted to submit proposals based on an alternate design for the caissons conforming to such criteria, but the lowest alternate bid received exceeded the lowest bid on the contract plan design by more than $1,600,000.

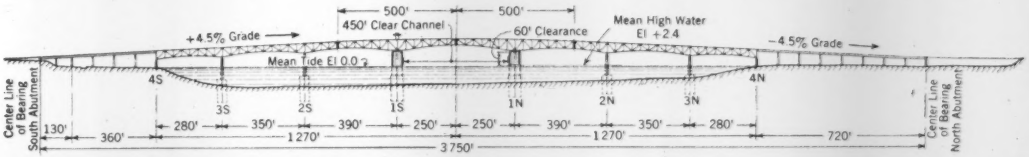
As designed, the caissons (Fig. 2) are all-welded steel boxes made of a $\frac{3}{8}$-in. continuous skin plate reinforced by steel wales 3 ft on centers and by soldier beams and struts. The total weight of steel in the six caissons is 3,700 tons—68 percent of the weight of the steel superstructure which the piers support. To save weight in the pier and reduce the quantity of structural steel remaining in place, the tops of the pier bases—and therefore the tops of the caissons in final position—were placed 40 ft below mean low water. During sinking, a temporary follower cofferdam 48 ft high is added to the caisson.

Two Caisson Fabrication Methods

The caissons were designed to permit fabrication by either of two methods: (1) The cutting edge and the lower portion could be built on inclined ways located at the site or anywhere within towing distance, launched and towed to the site, adding the remainder of the shell in increments as the sinking progressed; or (2) each entire caisson could be fabricated in one piece (maximum height 110 ft) at any deep-water shipyard on Chesapeake Bay and towed to the site with enough concrete in it to furnish the required ballast for towing. The contractor elected the latter method. All caissons were completely fabricated by the Newport News Shipbuilding and Drydock Co. in one of their drydocks at Newport News, Va., and were towed to the site. The draft during towing was approximately 34 ft.

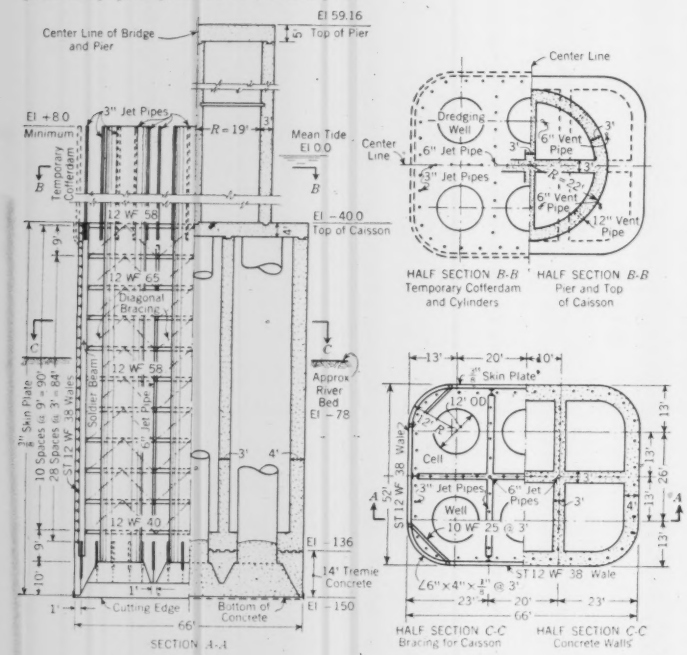
In the early stages each caisson is sunk by adding successive lifts to the concrete walls. After the cutting edge has penetrated the bed of the river, further sinking is accomplished primarily by means of excavation through open dredge wells installed for that purpose.

FIG. 1. EACH RIVER PIER consists of two parts: (1) a caisson 95 to 110-ft-high sunk in maximum of 80 ft of water to bearing 70 ft below river bottom; and (2) a concrete pier shaft 70 to 100 ft high. Thus total height of tallest pier is about that of 16-story building.



Since the caissons are essentially construction equipment, they are subjected to their largest stresses during the construction period and thereafter contribute very little to the structural strength of the completed pier. The caissons were therefore designed for stresses considerably larger than the working stresses ordinarily used for permanent steel construction. In general, these unit stresses were based on a working stress in tension of 25,000 psi except for the skin plate. Under the maximum hydrostatic head of 23 ft adopted for design, the bending stresses in this plate, when computed in accordance with the conventional method for a continuous plate on multiple supports, are considerably beyond the yield point of the steel. It was recognized, however, that in plates so supported, unit stresses based on negative moments at the supports are not a true measure of the strength of the plate. The skin was therefore designed on the basis of the "deflection" or "diaphragm" method, which is more frequently employed in ship than in bridge or building design.

FIG. 2. CAISSONS for six river piers are all-welded steel boxes of $^3/_8$-in. continuous skin plate reinforced by steel wales 3 ft on centers and by soldier beams and struts. Since tops of caissons in final positions are 40 ft below mean low water, temporary steel cofferdams are added to permit piers to be built in the dry. Caissons for two pivot piers are identical except that caisson for Pier 1S, here shown, is 9 ft deeper than 1N. Caissons for all river piers except pivot piers are 42 x 66 ft in plan.

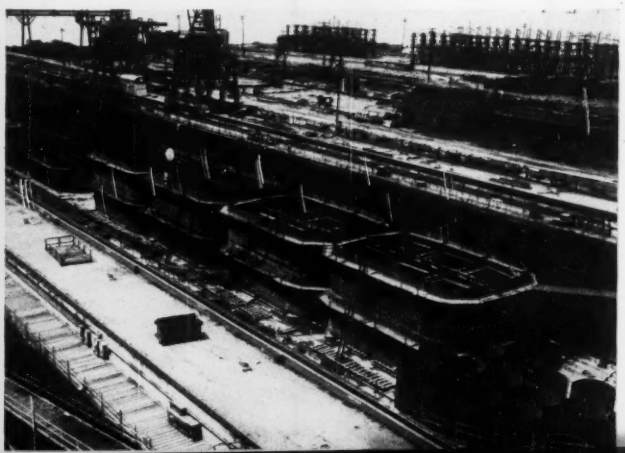


The $^3/_8$-in. skin plate is supported by ST 12 WF wales on 3-ft centers which in turn are supported by 6 soldier beams consisting of 18 WF 70 beams in the planes of the cross walls. Horizontal struts 12 WF 40 to 65 on 9-ft centers support the soldier beams and are stiffened by diagonals of two angles 4 × 3 × $^5/_{16}$. Each level of longitudinal and transverse struts is offset vertically by 6 in. to eliminate splicing. At the intersection point of the struts a 6-in.-dia extra-heavy pipe post extends from top to bottom through holes in the webs of the 12 WF struts. The pipes are welded to the struts and serve as structural posts besides being used for jetting during sinking.

Exhaustive Studies Made for All Piers

Because of the interrelation between the design of the completed pier, the caisson used to build it, and the sequence of construction, the engineers computed stresses and buoyancy conditions for 26 separate and consecutive stages of construction for Pier 1S. The results were included in the bidding documents

CAISSONS for all six river piers were fabricated at Newport News Shipbuilding and Dry Dock Co. Each caisson was fabricated in one piece of all-welded construction. At left, bottom cutting-edge section of caisson is being assembled.



to thoroughly acquaint the bidders with the scope of the work and the problems involved. Similar studies were made for the other piers.

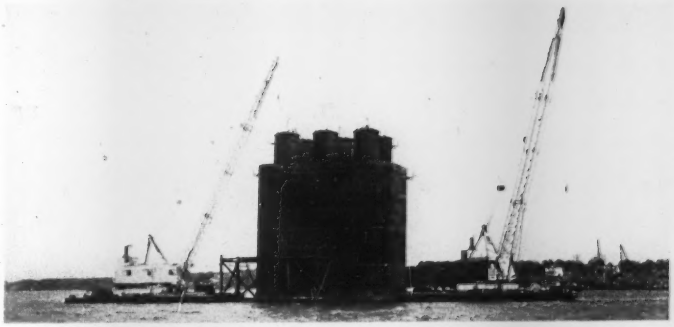
In these studies it was assumed that the contractor might wish to fabricate part of the caisson on launching ways either on or off the site. It was found that the lower 42 ft of caisson 1S, for example, could be so built, and the lower 14 ft filled with concrete prior to launching. Under these conditions the draft at launching would have been 28 ft. Additional lifts of the steel caisson would then have been added as it was sunk by the addition, in sequence, of lifts of the concrete walls.

Under normal buoyancy conditions, it was found necessary to limit the increments of walls to a 5-ft lift for each pour. Higher lifts would have increased the hydrostatic head on the $^{3}/_{8}$-in. skin plate beyond the design limit of 23 ft for the steel caisson acting alone, without support from the concrete walls. By the time any lift of the concrete walls is poured, the previous lift has gained ample strength to resist the added increment of water pressure on the outside.

After the first 20 ft of walls was poured, it was found necessary to advance the pouring of the exterior walls and defer pouring the interior walls to keep within the design limit of a 23-ft draft on the steel caisson. At times the interior walls are 20 ft lower than the exterior. The required differential is maintained until the caisson is firmly seated and does not float. Within the anticipated range of differential pours, the exterior walls are provided with keys and dowels to insure effective transfer of stress.

Since the construction of the interior walls lagged behind, many of the caisson struts and soldier beams are subjected to much greater hydrostatic heads than the shell plate and wales. Obviously this procedure is economical because of the relatively small amount of steel in the struts and soldier beams as compared to that in the skin plate and wales. A design based on uniform and simultaneous pours for all walls would increase the amount of steel in the caissons.

The contractor decided to cap the dredging wells with a reinforced flat steel plate and increase the buoyancy of the caisson by displacing some of the water in the dredge wells by compressed air. The added buoyancy permitted an increase in the height of each concrete pour to 9 ft (from 5 ft as originally designed) without exceeding the design head on the caisson skin except for the first few lifts above the initial pour. When the caissons were launched, the caps on the steel cylinders forming the dredge wells were in place and the cylinders extended 16 ft above the top of the caisson. When the caissons reached firm support, the caps were removed and later when the sinking reached the stage where the follower cofferdam was needed, a 32-ft extension was added to each dredge well.



INGENIOUS DOCK designed by contractor spots caisson in position for sinking. Three towers of dock are built before caisson arrives, one at center of each of three faces, and fourth tower is placed to complete enclosure when caisson is in position. Towers are built of welded pipe. Wells projecting above caisson are capped with steel plates so that some of water in dredge wells can be displaced by compressed air to increase buoyancy as required.

Thus far, the material below the bed of the river has proved to be somewhat firmer than the engineers and the contractor dared assume, and it has been found possible to complete most of the pours for the concrete walls without excavating in the wells between pours.

Advantages of Hollow Pier Design

The advantages of the light-weight, hollow design in reducing bearing pressures on the soil under the completed pier and in increasing buoyancy during the early stages of construction become disadvantages during the final stages of sinking the caisson. As the excavation in the dredge wells proceeds, added weight for overcoming skin friction and crushing and displacing the soil beneath the cutting edge is gained by flooding the spaces between the circular dredge wells and the caisson walls—the spaces used for buoyancy during the early stages of sinking.

This method has been used during the initial excavation but experience thus far has shown that in the final stages of sinking it is more effective to pump down the water in the dredge wells, thus reducing the effect of buoyancy. This is possible because of the unexpected impervious character of the soil at the cutting edge. Obviously, both procedures cannot be used simultaneously because the steel cylindrical dredge wells can withstand only outward hydrostatic pressure. Pumping down the wells results in a net gain of about 25 tons per ft of height (as compared to flooding the spaces surrounding the wells) and has the further advantage of lowering the center of gravity and therefore reducing the hazard of tipping in the event of an unsymmetrical "blow" under the cutting edge.

After the caisson reaches its final elevation, a 14-ft thickness of concrete is placed under water in the bottom through tremie tubes in the dredge wells. The dredge wells are then cut off below the top of the caisson and a 4-ft slab is poured in the dry over the entire top of the caisson. At the main piers, this slab is designed

STRUTS AND JET PIPES pass through webs in interior wall of caisson. Chain hoist is used to raise steel forms. Edge of a dredge well appears at left.

to distribute the load from the cylindrical hollow shaft resting on the pier base to the exterior and interior walls of the base. Since it could not be anticipated in the design that the hollow spaces in the base would remain permanently filled with air, vent pipes were placed through the top slab to insure uniform flooding when the cofferdam is removed.

The exterior and interior concrete walls in the base were designed for hydrostatic pressure incurred when the caisson is at its final depth with no water in the spaces surrounding the dredge wells. The curved corner sections are designed as unsymmetrical fixed arches, assuming points of zero rotation at the intersections with the interior walls. For this temporary condition, allowable working stresses of 1,350 psi for concrete and 22,000 psi for steel were used.

Dock Towers Hold Caisson

The shafts for the two swing-span pivot piers, 1N and 1S, are 44 ft in diameter and consist of a 3-ft-thick exterior wall and two mutually perpendicular interior walls also 3 ft thick. A 5-ft-thick top slab assists in distributing load from the center pivot to the exterior walls. Here again vents insure equal flooding of the interior spaces and maintain the same water level inside and outside the shaft. The shafts of the other four river piers are rectangular and solid.

To hold each floating caisson in position during sinking, the contractor has designed and is using an ingenious dock consisting of four towers, one at the center of each face of the caisson. Three of the towers are placed prior to spotting the caisson and the fourth completes the enclosure after the caisson is in place.

Each tower is 20 ft square and has four corner legs of 14-in. (O.D.) pipe extending from a point below the river bed to 10 ft above the water. The legs are braced by four planes of 45-deg X-bracing consisting of horizontal struts of 8-in. pipe and diagonals of 10-in. pipe. All bracing is welded.

Each tower leg is securely pinned to the river bed by a spud consisting of a $12\frac{3}{4}$-in. (O.D.) pipe 30 to 35 ft longer than the tower and driven inside the 14 in. (O.D.) pipe legs. The spud is driven until its top is within one foot of the top of the tower, then bolted to the tower leg. A yoke connecting the tops of the towers further secures the caisson in position. Three sets of towers were furnished. Each will be reused once.

Follower Cofferdams Used

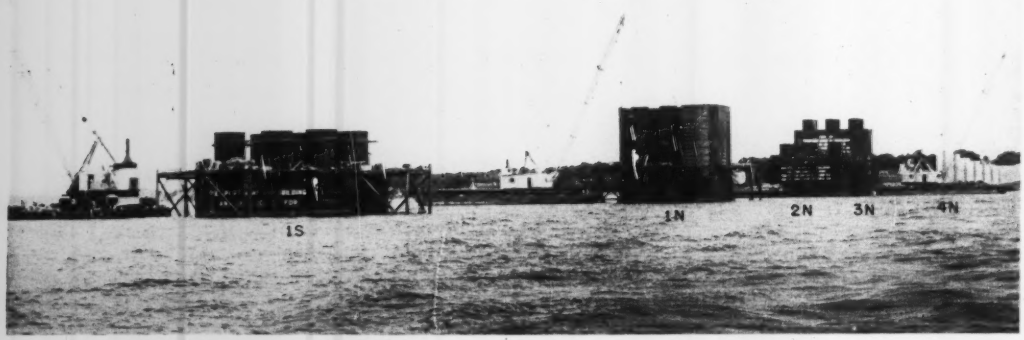
Rather than use conventional steel sheetpiling for the follower cofferdams, the contractor played it safe and avoided the problems and costs of pumping resulting from leaks by designing and using a structural steel cofferdam. The skin consists of $\frac{1}{4}$-in.-thick sag plates having sags of from 2 to 3 in. between structural T-wales on 2-ft 6-in. centers. Sag plates could not be used on the rounded corner sections. Here a flat plate varying in thickness from $\frac{1}{4}$ to $\frac{3}{8}$ in. was used. The sag plates and the wales welded to them are made up in panels 10 to 24 ft in width and 48 ft high. The panels are edged vertically with a $17 \times \frac{3}{8}$-in. plate and, on the bottom, with a $7 \times 4 \times \frac{3}{8}$-in. angle. The edge members contain holes for $\frac{3}{4}$-in. connecting bolts, the bottom connection being made to a matching peripheral angle welded to the top of the caisson.

Joints Gasketed with Garden Hose

All joints between panels and between the cofferdam and the caisson are gasketed with $\frac{5}{8}$-in. rubber garden hose placed on the pressure side of the connecting bolts. The interior bracing is steel and consists of soldier beams, struts and posts, similar to the caisson bracing, as well as rod diagonals for cross bracing. Three sets of cofferdams were furnished. Each will be reused once, the panels being arranged to fit both the two 66 × 52-ft main piers and the other four 66 × 42-ft piers by simply omitting two 10-ft panels.

The piers are being built by the Massman Construction Co. and the Kansas City Bridge Co., both of Kansas City, Mo., under a joint contract which for the entire bridge substructure will amount to approximately $4,700,000. The contract cost of the six river piers is about $4,230,000. Parsons, Brinckerhoff, Hall & Macdonald, Engineers, prepared the plans and specifications and are supervising construction. The bridge is being built for the Virginia Highway Department, of which C. S. Mullen, M. ASCE, is Chief Engineer, and William R. Glidden, M. ASCE, is Bridge Engineer.

SEVERAL CAISSONS are seen in various stages of sinking for river piers. Furthest advanced is that for pier 1N, to which cofferdam is being added. When caisson reaches bearing, top of cofferdam will extend 8 ft above mean high water in York River. As of February 1, caisson for 1N has been excavated to final elevation (−141.0) and concrete for pier shaft is being poured inside cofferdam.



Report of President's Water Policy Commission appraised

W. W. HORNER, Past-President ASCE, Chairman, Engineers Joint Council Water Policy Panel; Consulting Engineer, St. Louis, Mo.

THE PRESIDENT'S Water Resources Policy Commission released its 400-page report, "A Water Policy for the American People," on December 17, 1950. Because of its size, this report will require very careful study for a full understanding of its implications. In the meantime, however, certain highlights can be pointed out.

1. In many respects the report confirms the original Statement of Engineers Joint Council Water Policy Panel (summarized in CIVIL ENGINEERING for July 1950, page 21, and August 1950, page 22). For instance, the report states:

"There is today no single, uniform federal policy governing comprehensive development of water and land resources."

"This is a time for action based on sober consideration of objectives and methods. Continuation of present policies, or lack of them, will mean a continuing waste of money and effort in the pursuit of conflicting goals."

2. Although not permitted under the President's order to make recommendations for over-all administration of water resources, the Commission proposes that planning procedure be through drainage basin commissions, made up of federal agency representatives under an independent chairman, and with advisory boards representing the interested states. Except for the independent chairman, this is identical with the procedure set up by Congress in 1950 for the Arkansas Basin and for New England.

The report agrees with the Hoover Commission and with the EJC Water Policy Panel Statement in setting up a Board of Review to develop improved evaluation techniques and review and coordinate the plans of the various drainage basin commissions.

All federal agencies in cooperation with the states are to review all existing plans and programs. No new projects are to be put under construction until confirmed by such review. The Board of Review is to develop a six-year program of confirmed projects, the annual program to be adjusted somehow to national economic levels.

3. Many of the recommendations closely parallel those of EJC, as for example that public water supply remain a local responsibility, and that ascertainable direct dollar benefits become reimbursable to the Federal Government. Tolls are to be levied on inland waterways, but only as part of a new national transportation policy.

It is proposed that irrigation and public power be divorced, and that a pre-essential to irrigation undertakings be a finding by the Department of Agriculture of a need for additional productive land, after a full consideration of the increase in rate of production on existing lands. However, when undertaken, such irrigation projects are assumed to be justified as a national benefit, and the cost—less reimbursement from the farmers on an ability-to-pay basis—would be chargeable to federal taxpayers. While weight is to be given to the comparative cost of alternate projects for new lands, other safeguards would seem to be needed against uneconomic undertakings.

In the fields of hydroelectric power and of project evaluation, EJC and the Commission are far apart. With relation to hydroelectric power, the report proposes to clarify the situation for the first time with a flat statement of a specific policy. The recommended policy would make full development of the remaining hydroelectric power potential a major responsibility of the Federal Government, and in the future licenses for non-federal development would be issued only with the joint consent of the federal agencies.

With respect to the evaluation of projects, the report makes a strong recommendation for clear-cut accounting of costs and of those benefits which can be appraised in dollar values, this appraisal to include secondary benefits so as to provide an approximation of the total resulting increase in national income. This seems to provide for a material "judgment factor," but in addition, if on this showing benefits are less than cost, the basin commissions may make a statement indicating that essential benefits, important to the general welfare, are of sufficient additional value to warrant construction.

POLITICAL ECONOMIC philosophy of President's Water Resources Policy Commission may be indicated by quotations from its December 1950 report:

"The Commission is convinced that the measurement of direct benefits and costs in dollars is a basically useful tool in program evaluation and project selection, but that it must be supplemented by other measures if sound decisions are to be reached in the public interest." (page 64)

* * * *

". . . the assured permanence of our resources base would strengthen the foundations of our culture, institutions, and way of life. Improved productivity could relieve poverty, malnutrition, and insecurity among low-income groups. A widespread sense of well-being, hopefulness, confidence in the essential soundness of existing institutions could be achieved, along with a sense of responsible participation. These are social values of the highest order." (page 57)

* * * *

"Enough is known to support the judgment that the social values inherent in our water resources are immense and vital to the well-being of the Nation." (page 57)

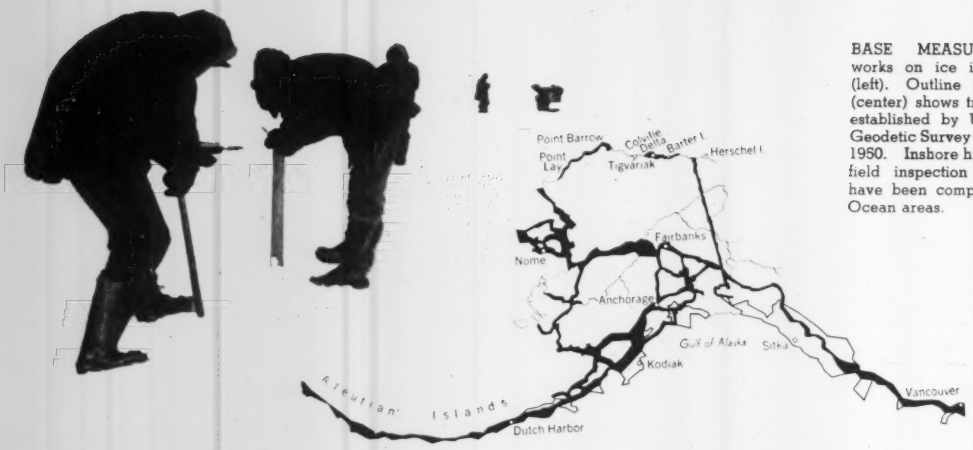
* * * *

". . . increasingly, as the Government has undertaken large investments for public purposes rather than simply to serve private purposes not fulfilled by private capital, the principle of full reimbursement has ceased to be useful or necessary. The Government has come to be recognized as an agency for social and economic action which need not follow the rules of the private capital market in order to obtain the necessary capital or to make investment decisions." (page 68)

EJC Review in Preparation

A preliminary review of the report of the President's Commission is now in preparation by the task force of EJC's Water Policy Panel. This task force consists of 90 representative engineers in the water resources field, organized into nine separate committees. It was this task force which prepared "A Statement of Desirable Policy with Respect to the Conservation, Development and Use of National Water Resources," filed with the President's Commission in June 1950, and previously referred to herein. The task force expects to complete its review of the President's Commission report in the next two months. The review will include a comparison between the statements of desirable policy as originally presented in the Panel Statement and as set forth in the Report of the President's Commission.

The Commission is now preparing a statement of specific legislation to be presented to Congress for the implementation of the policies set forth in the Report. When this statement is available, it also will be reviewed by the EJC task force and specific recommendations will be developed with regard to it.



BASE MEASURING PARTY works on ice in early spring (left). Outline map of Alaska (center) shows triangulation net established by U.S. Coast and Geodetic Survey as of October 1, 1950. Inshore hydrography and field inspection of air photos have been completed in Arctic Ocean areas.

Triangulation parties conquer Arctic to map Alaska

KARL B. JEFFERS, Commander, U.S. Coast and Geodetic Survey, Washington, D.C.

THE DEMAND for more and better charts of Alaska is a natural result of the increased interest in the Arctic. Development of the long-range airplane and a realization of global distances have made the Arctic a crossroads between the United States and major centers in Europe and Asia.

In the spring of 1945, the U.S. Coast and Geodetic Survey began field work along Alaska's Arctic coast in the vicinity of Point Barrow. The project includes the establishment of a system of marked triangulation stations, topographic compilations of shoreline areas from air photos, and detailed hydrographic surveys of inshore areas with particular attention to ice-free passages and anchorages.

The pioneer work of organizing, developing procedure, and outfitting the party was done by Capt. R. W. Woodworth, M. ASCE. All available sources of information were thoroughly investigated, endless lists of supplies and equipment were prepared, and detailed instructions for field parties were written based on his investigations—all of which contributed to the very successful beginning of the project.

The first year of field work disclosed the necessity for longer range planning, and it was decided to send supplies to the Arctic one year in advance of contemplated operations. No field work was done in 1946 but supplies were shipped to Point Barrow for resumption of work in 1947. This party worked southwestward from Point Barrow. A second unit was organized in 1948 with base camp at Barter Island.

Base Camps Selected a Year Ahead

Locations for base camps are selected a year in advance so as to permit off-loading of supplies during the summer and establishment of a temporary camp to provide for winter storage. In some cases supplies must be off-loaded at a point several miles from the camp site, which means overland movement. Every effort is made to keep the amount of heavy hauling to a minimum, but on one occasion several hundred tons of equipment and supplies were moved a hundred miles, and another involved a trip of approximately 400 miles. Plans are now in preparation for a 300-mile haul in 1951. This work must be done between January and late April.

Routes over lagoons and lakes are selected to avoid the heavy drifts in gullies and streams. Travel over the sea ice along shore is possible but dangerous and is to be avoided. Two types of sleds are used—the conventional bob-sled and a sled built of welded pipe which is much more rigid than a bob-sled and more suitable for hauling launches and bunkhouses or wanigans. Caterpillar tractors must be equipped with winches or a great deal of time is lost in doubling up or digging out. A D-7 or a D-8 tractor can tow a load of 50 tons or more without undue stress at a rate of 3 to 5 miles an hour over smooth terrain. It is sometimes advantageous on long hauls to have a dozer go ahead to clear the trail.

On long hauls a reconnaissance unit goes ahead in a weasel to select the best route and mark it with bamboo poles carrying red or black flags. Snow drifts are so hard that drivers must avoid straddling them to avert the danger of high-centering their vehicles. Dozers are essential for digging out a camp that is to be moved and for clearing space for a new camp.

Personnel are housed in portable Arctic huts constructed in 4-ft sections with insulated floors and blanket-type covers stretched over wooden bows and lashed to the floor boxes. In two hours a party of five men can set up a hut and have the fire going. Mess wanigans are small houses about 10 x 24 ft, built on pipe sleds. They seat ten or twelve men and carry supplies for that number for approximately four weeks. In winter water is obtained by chopping ice from the nearest pond or lake and in summer it is hauled in milk cans or special water drums from streams or lakes. To get fresh water on the sand islands is more difficult in summer than in winter because of the prevalence of shoal areas behind the barriers and the long hauls involved.

PROSPECTOR'S BOILER steams hole in tundra for guy-wire stake. Same method is used for placing station pipe markers in frozen tundra. In background is snow jeep.

TRIANGULATION unit of six men sets up temporary camp in early spring (top right). In this case, mess wanigan was equipped with temporary removable bunks. Train (lower right) consists of two sleds loaded with lumber and fuel and mess wanigan hooked together and pulled by D-7 tractor equipped with winch. Wanigan is small building 10×24 ft, mounted on pipe sled. Tractor can tow load of 50 tons.

The ponds on the barrier islands are salty. At one island station this past season an ice house was built and insulated with quonset-hut material with very good results.

Refrigeration problems are easily solved by digging a shaft in the tundra about 20 ft deep and expanding the base sufficiently to accommodate the supplies. Frozen meat will keep indefinitely in such a cellar. Such ice cellars cannot be used on the sand islands in summer as they are subject to heavy seepage.

The date set for sending a party into the field is determined by considering the heavy hauling required, the distances involved, the amount of control surveying required and the locality. In the eastern part of Arctic Alaska, the rivers have a much shorter course to the sea than they do in the west. The initial flow of these rivers begins in the mountains, which means that the rivers in the east are subject to earlier flooding than those in the west, so that in general, weasel travel is safe from two to three weeks later in the west. Control survey work can be done until late May in the eastern areas, and until the middle of June in the western areas.

A weasel is an amphibious tracked vehicle which can carry four passengers and tow light loads. Originally designed for use in temperate or tropical climates, the weasel has proved very satisfactory in the Arctic.

Personnel Transported by Plane

The chief of party should anticipate all his needs for several weeks to cover the break-up period between snow and open water, approximately June 1 to July 15. All transportation of personnel and resupply is by airplanes which operate on skis during most of the year and on floats during the open-water season. Pilots can land their planes almost anywhere on skis or floats but there are few places where safe landings can be made on wheels. Should the need arise, a large airplane, such as a DC-3, can be landed on strips cleared on the ice.

Fortunately no serious illnesses have occurred in field parties during the past three seasons, when they were operating at a considerable distance from competent medical aid. This is the one bad feature of work in such isolated areas and is only partially alleviated by radio contact and the availability of airplanes in emergencies. Sometimes the radio is completely blanked out for periods varying from a few hours to several days, and at other times the weather prevents all flying for days. Only those in top physical condition should be sent out on this project, and they should be given a thorough physical examination before and after a season in the Arctic.

The operation of mechanical equipment in the spring requires special servicing and maintenance. Motors are preheated before starting and carefully warmed up before the vehicle gets under way. Number 10 oil is used, but at −30 deg F it becomes thick. Tracks and skis should be broken loose to avoid undue strain on the final drive. Tractor engines are kept in operation continuously 24 hours a day until cat-train work is completed. Weasel and snow-jeep motors are never stopped when they are away from camp during periods when the temperature is below 20 deg F.

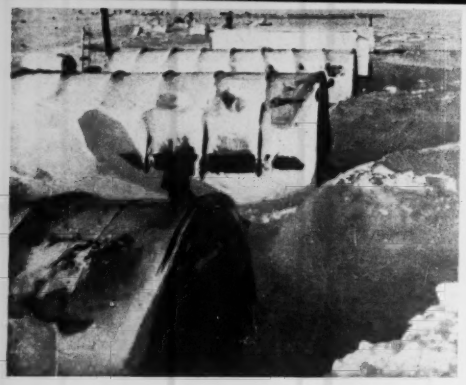
It is essential that each unit operating away from a camp be accompanied by an Eskimo. The uninitiated always have difficulty in keeping themselves oriented and will become hopelessly lost if a sudden blizzard strikes, or if a strong wind begins to blow. The ability of the Eskimo to find his way to a definite point through a blinding snow storm is amazing and seemingly instinctive, but is actually the result of long experience in using the wind and snow drifts as compasses. Safety of personnel demands the presence of an Eskimo guide, and experience has proved the Eskimo to be an excellent workman. The entire history of Arctic exploration is a story of the friendliness and assistance of the Eskimo.

Extra Supplies Always Carried

All field parties ashore or afloat are required to carry supplies and equipment sufficient to survive several days should they become snow or ice bound or otherwise delayed through breakdown of equipment. Tinted glasses must be worn to avoid the severe pain of snow blindness. The Eskimo deer-skin mukluk has been adopted by everyone who works outdoors in the Arctic. The deer-skin pants and parkas which have been used by explorers for many years have been replaced by garments which are lined with eiderdown or fiber glass. Much work has been done in recent years in the development of Arctic clothing.

Vehicles, boats, and buildings are generally painted International Orange, which is visible for great distances against any background. Radio contact is maintained between the base and detached parties.

In the United States the Survey works in the north in summer and in the south in winter, partly to avoid the discomfort of cold weather and partly to eliminate hard digging in frozen ground. In the Arctic it is best to reverse this procedure and ex-



LOCATIONS FOR BASE CAMPS must be selected one year in advance to permit offloading of supplies during summer and provision for winter storage. February 1949 view of Barter Island base camp (left) shows 16×32-ft Janesway huts and drifts caused by prevailing northeast winds. Base camp at Tigvariak Island (right), seen after cat haul from Barter Island, includes canvas-covered garage at right, 16×16-ft storage huts and 16 × 32-ft Janesway huts, with weasel in foreground.

ecute control surveys when the snow is on the ground. Nearly all overland travel is done in the winter, whether by dog team or tractor.

Clear Weather Occurs in Spring and Fall

Astronomic observations must be made in early spring or fall when periods of clear weather occur. Experience to date indicates that this work can be done best in September and October when temperatures are much less severe than in February and March. In the early spring, clear days mean cold days, and temperatures of −30 to −10 deg F are not conducive to the successful operation of precision instruments. The aurora interferes with the reception of radio time signals in both spring and fall.

Reconnaissance for triangulation is a very difficult operation in winter as there is seldom a definite horizon line except to seaward, where a dark blue line indicates open leads. Glare reduces visibility even though sunglasses are always worn. The land along the Arctic coast is generally flat, with few prominent hills and only some small mounds east of the Colville delta. The unbroken white of the snow seems to have a leveling effect, which is more evident at some times than at others. At times it is dangerous to travel, as a man may walk or drive over a drift or bluff without seeing it.

A special type of station mark has been developed for control points in frozen ground. A station disk is brazed to one end of a 5- or 6-ft section of 2½-in. brass or galvanized wrought-iron pipe in which several small holes have been drilled. A small portable prospector's boiler is used to steam a hole into the tundra and the pipe marker is set in the mud and water, which freezes again in about half an hour. Reference marks are set in the same manner. It is too early to say how permanent these marks will be but evidence to date indicates good stability.

Considerable difficulty has been encountered in making observations. Instruments constructed for use in warmer climates will bind or drag in their circular movements in very cold weather, although those with temperature adjusting devices are satisfactory under all conditions. Second-order accuracy has been specified for the coastal arc. Very little reoccupation of stations was required in 1948 but both units found it necessary to reoccupy approximately 60 percent of the stations in 1949 to obtain satisfactory triangle closures. An effort to do triangulation work in summer was made in 1948 but had to be abandoned because of excessive refraction. Reconnaissance, however, should be done at this time of the year in my opinion, even though travel is much more difficult.

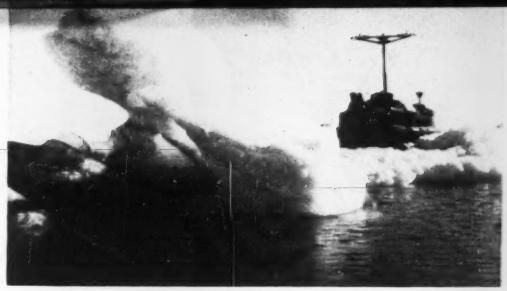
A triangulation unit has a complement of one officer and eight men divided into reconnaissance, signal building and observing parties. It is possible to double up the reconnaissance and observing or signal building and reduce the complement by two. Equipment includes a mess wanigan, a bunk wanigan, and a supply sled hooked in a train and towed by a caterpillar tractor. Three weasels are required for the field work. One or two snow-jeeps may be substituted for an equal number of weasels. The snow-jeep, a half-track with skis at the front end, is especially useful in reconnaissance and signal building. It carries two passengers and can tow small loads.

The cat-train is kept hooked up and the party moves down the line as each quad is completed. Frequent moves are made to avoid loss of time in traveling to the station from the camp and to keep the observing party near enough to the station so that short periods of good observing weather can be used to advantage.

Base lines are laid out to take advantage of lakes or lagoons, in which stakes can be more easily set than in the tundra. The tape end supports are steamed into the ice. An eight-man party is required and about two miles can be staked in an eight-hour day. It is best to delay base measuring operations until late April or early May, when average temperatures are above zero and hands can be exposed without danger of freezing.

Triangulation field work the past three seasons has been carried out by two mobile units working on separate parts of the arc, either towards each other or away from a common starting point. In the first case the parties should not start so far apart as to risk failure to join before the end of the field season. Each party completes triangle computations to assure compliance with requirements for the order of work specified. Base lines are measured when the summation of R-1 (the strength of figure) reaches approximately 100, and figures are made as strong as possible to get the maximum distance between bases.

After the rivers begin to flow and it becomes unsafe to travel over the ice, there is a period of six to eight weeks when little if any field work can be done. This time is utilized in overhauling equipment and taking inventories, completing triangulation computations, inspecting and servicing hydrographic instruments, boats and tide gages, and making preparations for receiving the supplies due on the summer shipment. Boat sheets for plotting purposes are made ready and personnel trained for hydrographic work. A tide gage is installed as soon as ice conditions will permit, and fathometers for depth



HYDROGRAPHIC WORK is done mainly by 35-ft seaplane rearming launches equipped with fathometers and two-way radios. Boats are put in water as early as possible, as open-water season is short. Above, launch equipped with shoran mast takes soundings in brash ice to edge of ice pack. At upper right, TD-9 tractor tows launch on specially built skid runners. Below, boats are lined up ready for launching. Note canvas-covered canopies, coxswain station on stern, and outboard fish mount on starboard side of launch in foreground.

measurements and radios are installed in the launches, which are put in the water as soon as possible. All hydrographic signals should be built while vehicle travel is still possible so that no time suitable for hydrography will be lost.

Hydrographic Work in Open-Water Season

The open-water season is short and the weather is often unfavorable—usually 40 to 50 percent of the season is spent in waiting for the winds to "blow themselves out." Southwesters are the most violent but usually do not last long. Northeast winds at 20 to 30 miles an hour blow for days at a time. Camp sites for hydrographic parties are few and far between for lack of suitable safe anchorages.

The coast west and south of Point Barrow is usually free of ice from the first of August to late September, but east of Barrow the ice is nearly always in sight and sometimes never leaves the beach. The pressure ridge at Barter Island did not move out at all during the 1948 season, and the presence of ice along the McClure Islands throughout the 1949 season prevented execution of hydrographic surveys outside the barrier islands. Lagoons and anchorage areas freeze in late September.

Thirty-five-foot boats used by the Navy to rearm seaplanes afloat have been adapted to hydrographic use. These boats have plywood hulls, are powered by Chrysler Crown marine engines and operate at a speed of 7 to 8 knots. The under-water body is sheathed with copper to prevent damage by ice. The 808 type of recording fathometer is used with the fish mounted outboard. Experiments are being made to develop a suitable inboard mount. Transmission of sound through the plywood and the flow of air bubbles under the hull in choppy seas present two problems that remain to be solved.

Standard methods have been used as described in the Hydrographic Manual of the Coast and Geodetic Survey. Frequent periods of fog and haze reduce visibility for three-point fixing of position with the sextant. Shoran equipment was sent to Tigvariak for use in the 1949 season but did not function properly. However, this equipment was used again in 1950 with excellent results. Hydrography is done on a scale of 1:20,000 in bays, harbors, and lagoons; and on a scale of 1:40,000 in offshore areas. An effort is made to develop the 10-fathom curve along the coast as it serves as a guide to shipping and marks the inshore limits of steamer tracks.

The continental shelf lies 40 to 50 miles offshore along the coast between Hershel Island and Point Barrow and continues in a northwesterly direction into the Arctic Ocean. North of Bering Strait, between Alaska and Siberia, lies the Chuchi Sea, which is very shallow throughout.

From Bering Strait to Point Barrow, the current flows northeasterly except after long periods of northeasterly wind, which reverses the flow. Along the north coast the current sets westerly to Point Barrow, where it encounters the other stream and forms an eddy. These currents may reach a maximum velocity of two knots but are generally less than one knot. Our knowledge of currents in this area is very limited.

The tide in Arctic Alaska is very small, having an average range of one foot or less. Tide level is largely dependent upon the wind. Southwesterly winds raise the water level and northeasterly winds lower it, producing a maximum range of about 5 ft.

Daily temperature and salinity observations are recorded at all tide stations. Serial temperature and salinity observations are made periodically by the hydrographic parties. Early in July 1950, the temperature curve of the sea water off Point Lay followed the normal pattern of warm water on top with gradually decreasing temperature to the bottom. On July 28, a warm current came in from the south, raising the surface temperature about 2 deg and the bottom temperature 4 to 5 deg, the temperature from top to bottom being uniform in 10 fathoms. This condition held through the remainder of the season, which ended September 15.

Mapping of 450 Miles of Coast Completed

At present, triangulation has been established and inshore hydrographic surveys completed along 450 miles of the Arctic coast of Alaska. The party now based near Point Lay will be moved east of Point Barrow in 1951, and it is hoped that work on the north coast will be completed in 1952.

Until natural resources are discovered and exploited in northern Alaska, it will never assume any great importance except as a front line of defense. There is little need for water-borne traffic in the area. In contrast, the Arctic regions of Soviet Russia are of great interest. Her large north-flowing rivers serve as freight routes for the transportation of lumber, coal, furs and other products of Siberia, which are carried westward by a fleet of freighters convoyed by one or more of thirty large ice breakers built for this route.

Russia has taken the lead in research concerning permafrost areas and has made great strides in developing her Arctic and sub-Arctic regions. It is not probable that the Arctic regions of North America will be developed to this extent in the foreseeable future but adequate charts and maps will be available if needed.

Chicago builds $230,000,000

CONSTRUCTION OF WACKER DRIVE EXTENSION proceeds through congested Loop area of Chicago. Eight-block double-deck extension occupies present Market Street (widened to 134 ft) and will connect with Congress Street Superhighway (West Route), also under construction as part of current program.

ANOTHER VIEW of Wacker Drive Extension shows completed upper decks of first two blocks and excavation for intersection in foreground. Completion is planned for 1957.

V. E. GUNLOCK, M. ASCE

Commissioner of Subways and Superhighways, Chicago, Ill.

IN THE PAST 25 years Chicago has spent about 250 million dollars to open new streets and widen old ones. This extensive building and widening program has helped a great deal, but the point has been reached where the addition of another major thoroughfare on an already overcrowded pattern of streets only serves to create more intersections and more interference to traffic flow.

After a thorough study of all street transportation, the City Council in 1940 adopted a general plan for a comprehensive system of superhighways. This system included the famous Outer Drive which had been built along the lake front from Foster Avenue on the north to 47th Street on the south, as well as Wacker Drive which had been constructed as a double-decked street along the south bank of the Chicago River from Michigan Avenue to Lake Street.

Since its adoption, this system has been reviewed thoroughly by the several city departments concerned with highway traffic, and by other city, county, state and government organizations. As a result revisions have been made to permit proper connections to county, state and federal routes. The official plan, dated June 25, 1947, is shown in Fig. 1.

The original system of superhighways was estimated to cost about $205,000,000 at 1938 cost levels. Since then, additions to the system and increases in cost have expanded the plan to include the 67 miles of superhighways shown in Table 1 and Fig. 1, estimated to cost $446,000,000. Because these superhighways are designed as part of an overall system, the City of Chicago, Cook County, the State of Illinois and the federal government are sharing in the cost of their construction.

Even with this sharing of costs, the funds in sight are insufficient to finish the entire system in a reasonable time. Therefore, a priority system costing about $230,000,000 has been programmed for completion by 1959. This system includes all of the West and Northwest Routes, the Wacker Drive Extension and sections of the North, Southwest and South Routes, slightly more than half of the total mileage and cost. Unless substantial additional funds can be found for this work, completion of the total plan will be too long delayed.

TABLE I. CHICAGO SUPERHIGHWAY COST ESTIMATES

Route	Miles	Cost	Planned Completion Date
North	3.5	$ 31,000,000	1953
Northwest	16.3	128,000,000	1957
West	8.0	80,000,000	1954
Southwest	5.5	32,000,000	None as yet
South	17.0	84,000,000	None as yet
Southeast	8.2	33,000,000	None as yet
Crosstown	7.5	40,000,000	None as yet
Wacker Drive Extension	0.7	12,000,000	1957
Addition to Wacker Drive	0.3	6,000,000	None as yet
Total	67.0	$446,000,000	

Chicago will use motor-fuel tax funds in the amount of $34,000,000 and superhighway bond funds in the amount of $42,000,000 to finance its share of the work. Cook County will use motor-fuel tax funds, highway tax funds and bond-issue funds for its share. The state will use motor-fuel tax funds and federal-aid funds for its share. Beyond this the financial picture is dim, but it could be improved by a reduction in the cost of the work; a larger allocation of federal, state and county funds to work within the city; and more highway funds through an increased motor-fuel tax.

Chief Features of Design

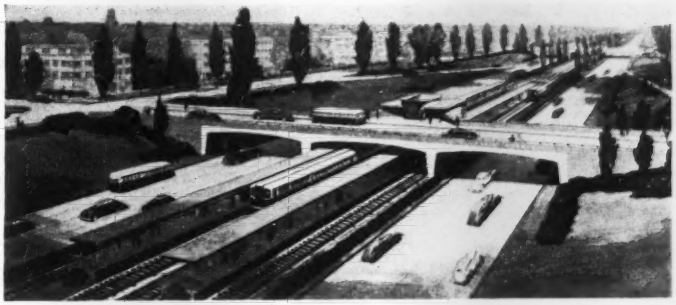
Some of the fundamental design features are:

1. All cross traffic, both pedestrian and vehicular, is to be eliminated by depressing the roadways or, in special locations, by elevating them.

2. Only important streets will be carried over the depressed section; all other streets will be cut off.

Superhighway System

DESIGN OF CONGRESS STREET SUPERHIGHWAY, or West Route, shown by artist's sketch, provides four-lane roadways in each direction and subway extension in median strip. Completion is planned for 1954.



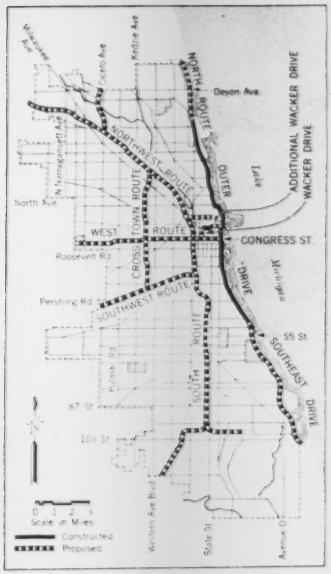


FIG. 1. CHICAGO'S official plan for integrated superhighway system provides proper connections to county, state and federal routes.

3. Main roadways will usually consist of four or more 12-ft traffic lanes in each direction with a capacity of 1,500 vehicles per hour per lane.

4. Opposing streams of traffic will be separated by a median strip, usually 24 ft wide, but reduced to a 4-ft width on structures.

5. Maximum grade will be 4 percent.

6. Design speed is 60 mph for main roadways.

7. Access will be by entrance and exit lanes at controlled locations only. Abutting property will have service drives at street level to connect with entrance and exit lanes.

8. Provisions will be made for use by mass transit vehicles. In the Congress Street Superhighway (West Route) the existing elevated structure will be removed and tracks of the new subway will be laid in the median strip.

9. A continuous shoulder 10 ft wide will be provided for disabled vehicles.

10. Unpaved parts of the right-of-way will be suitably landscaped.

11. Pavements will be 10-in.-thick concrete on a granular base.

At the junction of the West, Northwest and South Routes near Congress Street and Halsted Street a complete interchange is planned. Here, to avoid any crossing of traffic lanes at grade it will be necessary to construct 39 structures in an area two blocks square. This interchange is further complicated by a subway portal where the subway tracks go into the tubes under the Chicago River to the east. This interchange, where two roads with a capacity of 6,000 vehicles per hour in each direction will cross, will be a busy place.

Wacker Drive, which is a double-decked inner distributor for the superhighway system, is connected with the West Route at the east bank of the Chicago River by means of a half cloverleaf interchange which permits traffic only to and from the west.

Special Problems on West Route

Each of the routes has its engineering problems, but the West Route along Congress Street seems to have more than its share. This route passes through the huge U. S. Post Office Building, which was constructed with pass-through roadways at grade in 1933. As the superhighway is to have no crossings at grade, extensive revisions will be necessary in the Post Office roadways.

The Congress Street Superhighway also passes through the La Salle Street Railroad Station, where it will go under the tracks of the New York Central Railroad and the Rock Island Railroad. Immediately to the east of this station the highway will cut off the south 35 ft of the Western Union Building. Since most of the cables and instruments are in this end of the building, careful planning and execution of the work will be required to keep this important public utility in operation.

Bureau for Tenant Relocation

One of the most disagreeable tasks is to evict the people who live and do business in the buildings on the acquired right-of-way. On each of the three major routes about three thousand dwelling units will have to be vacated. This work is well along on the West Route and has been accomplished with a minimum of hardship and friction by a city-sponsored Tenant Relocation Bureau which established offices in the neighborhood to assist the people being evicted. Relocation of people will be handled in the same way on the Northwest and South Routes. It is not a problem on the Wacker Drive and North Routes. Construction has been started on all except the South Route.

It is believed that the construction of Chicago's new superhighway will stimulate the redevelopment of old neighborhoods, ensure a sound confidence in the economic future of the city, and promote sustained and healthy growth.

Should we reconsider

COMPOSTING OF ORGANIC REFUSE?

MAX L. PANZER, and HARVEY F. LUDWIG, Assoc. M. ASCE

Respectively Research Biologist and Associate Professor of Sanitary Engineering, Sanitary Engineering Research Project, University of California, Berkeley, Calif.

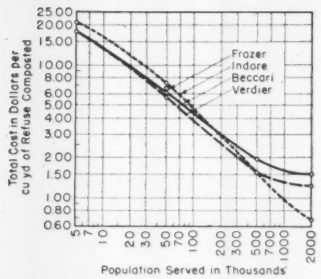


FIG. 1 ESTIMATED COSTS of composting refuse are shown by curves. Estimates include costs for final drying and for grinding and screening out of undisintegrated rubbish. Excluded are land costs, haulage costs for residual rubbish, and returns from sale of humus. Conditions are assumed which would permit satisfactory adaptation of processes for use in the United States.

IS THE COMPOSTING of organic refuse, as a means of waste disposal, entering the realm of economic feasibility in America today? Many European cities have used this method of disposing of community garbage and organic refuse for many years. In contrast, not one American city employs composting today for the disposal of organic waste, and very few have tried or even considered it. American practice has preferred the simplest and most direct means of disposal, generally incineration or sanitary land fills, with little if any regard to the possibilities of reclaiming valuable agricultural materials. Such reclamation as is practiced consists of separating out materials with an immediate sales value, such as bottles and metals which may be reused or garbage which may be fed to hogs.

Most Economical Methods Used

The methods of disposal used by American cities in general have been the most economical possible considering the factors involved. In recent years, however, in many places in the United States, and especially in California, important changes due to the increasing density of population have altered the basic economics of refuse disposal. Land areas suitable for fills are becoming increasingly scarce and must be located at greater distances from the community. Incineration has become more expensive because of the increased importance of protecting the atmosphere from pollution. At the same time the public has become increasingly aware of reclamation needs. People are beginning to wonder whether disposal practices which ignore possible reclamation values are actually the best, even if they are computed to be the cheapest under existing conditions. These changing factors have reopened the question as to whether composting should be seriously considered by American communities as a feasible method for disposing of organic refuse.

Through the process of composting, practically all types of organic material can be altered to produce humus. The traditional composting process has been adapted to large-scale use in various ways to meet conditions in different parts of the world. The most important methods thus far developed are batch processes, such as the Indore, Beccari, and Verdier, developed during the decade 1920–1930 and since employed successfully in many places. Continuous or mechanized methods have been developed only recently, including the Dano process in Denmark and the Frazer process in this country. Installations are few however, and data are scarce concerning their feasibility. All processes produce a humus which has to be dried, from about 30 to 15 percent moisture, before it can be conveniently used.

Batch Composting Processes

The Indore process is essentially a large-scale application of the traditional barnyard process. Alternate layers of readily putrescible materials, such as garbage, and relatively stable organic materials, such as straw and leaves, are piled up, on the open ground or in a trench, to a height of 5 ft. If available, night soil or sewage sludge is distributed throughout and functions as seed, serving to shorten the fermentation period to the minimum of about 15 days. During this period the materials are turned twice, manually. The liquors draining from the pile may be collected and recirculated through the mass.

This process is widely used in India, South Africa, China, and similar places where fertilizer is scarce and in high demand and labor is cheap. It could be adapted for use by American communities by employing mechanical equipment, but would still have serious disadvantages, especially lack of protection from adverse weather and probable difficulties with odor and pest nuisances.

The Beccari process, developed in Italy, attempts to solve these problems by enclosing the mass of materials in a cuboidal cell, usually of 20-cu yd capacity. Vents equipped with valves are incorporated in the cell so that air can be excluded at first and admitted later. The first stage of the process is anaerobic, during which the temperature rises to about 150 deg F, and the volume shrinks considerably. The vents are then opened, changing the nature of the reactions and allowing the mass to dry out partially. This process is being successfully employed by some 50 municipalities in Italy and France, but has not been successful

in this country. During the period 1920–1930 there were five American installations, one at Scarsdale, N.Y., and four in Florida. All were abandoned during the depression.

The Verdier process, an improvement on the Beccari process, is employed by several communities in southern France. The principal modification is recirculation of the drainage liquor, which reduces the retention period from 35 to 22 days.

Mechanical Composting Processes

The Dano process is employed by about 12 communities in Denmark and Sweden, and has been particularly adapted to refuse containing large amounts of paper. It is highly mechanized, and comprises two rotary drums operating in series. In the first unit, called the silo, the rotation aerates the refuse and breaks up the larger particles. The second unit, called the egsetor, is furnished with stationary grinding bars and screens, and provides further aeration and grinding down to final size. The total retention period is only a half day, so that the process is not complete composting but a conditioning which prepares the material so that it can be stored by the consumer without developing a nuisance. Final composting takes place during storage.

The Frazer process, developed by the Frazer Compost Corporation of Chicago, is also highly mechanized. Aeration is employed in that air is forced upwards through the waste materials moving down the tank. The retention period is from 5 to 7 days. A single fabricated steel digester tank has 3,000-cu ft capacity and can receive 50 tons of refuse per loading. At present there is only one installation, a demonstration unit handling manure at the Chicago Union Stock Yards.

The Earp-Thomas process, developed by G. H. Earp-Thomas of Hampton, N.J., also employs grinding, agitation, and aeration. In addition the raw materials are inoculated with a special culture of bacteria. The only plant employing this process known to the authors is at Penticton, British Columbia. This plant does not employ a digester of the type described in Earp-Thomas's patent but does make use of his cultures. The need for such cultures is doubted because the evidence available in the literature indicates that the most successful compost inoculum is an infusion of a previously successful compost.

The composting processes described are partially aerobic, and produce little if any gas usable for fuel. It is possible to stabilize organic refuse through entirely aerobic processes, in the same way that sewage sludge solids are disposed of in a treatment plant digester. This method produces gaseous fuel in addition to the humus of aerobic digestion. The disadvantages of anaerobic digestion are a lower efficiency in the microbiological reactions, resulting in longer retention periods and the production of odiferous gases. Anaerobic digestion of organic refuse is practiced in European countries where fuel is scarce, as in Germany and Italy. It is strongly advocated by Imhoff.

Disposal Into Sewage System

In the United States more and more communities are disposing of garbage by grinding and discharge into sewers. At these places the ground garbage is largely recovered in the sewage sludge, and undergoes digestion with it. As compared with separate composting, disposal of organic refuse together with the sewage sludge has the distinct advantage of making efficient use of existing sewer and sewage treatment facilities. Use of the sewers for transporting the ground garbage may decrease or even eliminate separate collection in some areas, and sewage treatment plant digestion facilities, when built or enlarged, can be given the capacity to care for the extra load. Increased production of fuel gas and of humus fertilizer will help offset the additional costs to the sewerage system.

Economics of Composting

Technical literature contains little regarding the cost of composting, and insufficient design and operation information to permit the preparation of really reliable estimates. Approximate cost estimates have been prepared, however, for the conventional Indore, Beccari, and Verdier processes, by assuming conditions that would adapt these methods for satisfactory use in the United States.

These estimates, Fig. 1, represent total costs, and include an estimate for the Frazer process for the size of community (50,000) which could efficiently use this Frazer unit. They exclude land costs, and make no allowance for returns from the sale of humus. They include costs for final drying, grinding, and screening out from the humus of any undisintegrated rubbish, but do not allow for hauling away and finally disposing of such residual rubbish. The type of refuse assumed in preparing the estimates is municipal garbage averaging 0.5 ton per cu yd. The humus product removed from the composting cell is assumed to have a water content of 30 percent, which is reduced by drying to from 10 to 15 percent.

The history of composting progress indicates that the most economical process for use in the United States may prove to be a mechanized one in which the digesting material moves continuously throughout the period of digestion. When reliable design and cost data become available for continuous methods, these methods probably will be found to be considerably less expensive than the conventional noncontinuous methods.

Sales Value of Compost Humus

The best criterion of the probable sales value of compost humus is the salability of dried digested sewage sludge, but even here the record is inconsistent. Some digested sewage sludges, such as Milwaukee's "Milorganite" and Kellog's "Nitrohumus" in Southern California, are selling readily for prices exceeding $40 per ton. In other places, revenues from the sale of sludge have barely paid the cost of hauling it away.

The bulkiness of humus as compared with commercially available competitive products makes it unlikely that it can feasibly be sold at places located far from the source. All factors considered, an estimated figure of $15 net per ton of dried humus (derived from approximately 10 cu yd of organic refuse) represents a reasonably average figure. This amounts to $1.50 per cu yd of raw organic refuse, which would be only a part of the total cost of disposal for any but very large municipalities.

For smaller cities and communities at least, municipal composting of organic refuse may become definitely competitive with other means of disposal at places where sanitary land fills cannot be used. The process may be advantageously employed by communities where the composting plant can be located adjacent to the sewage treatment works, so that sewage sludge will be readily available. Composting may also prove advantageous for unsewered communities, where septic tank and cesspool pumpings can be disposed of together with garbage and other organic refuse.

LAW — Independent contractor or employee?

WALTER C. SADLER, M. ASCE, Civil Engineer and Attorney at Law, Ann Arbor, Mich.

THE DESIGNATION "independent contractor" is a rather deceptive term of potentially great legal significance. It is applied to the builder or manufacturer who contracts to produce a finished product, but who retains the freedom to choose his own means and methods. When an independent contractor undertakes a project, he is responsible for injuries resulting from the negligence of the workmen, and for nuisances which they make.

In addition to these liabilities in tort, new obligations are arising in the form of federal and state taxes for social security, unemployment insurance, and workmen's injury compensations. These liabilities are augmented by wage and hour legislation, arbitration and labor contracts. In some states an unlicensed independent contractor cannot collect for his work, while a foreman hired by the owner can collect. Under the many complex statutes it becomes paramount to determine whether the workmen are employees of the owner with the contractor a mere servant or agent of the owner; or whether the workmen are employees of the contractor as in the independent contractor relationship.

In this cursory perusal of the topic it will be noted that there are many factors involved, some indicative of an employee relationship, and others indicative of an independent contractor relationship. Most of these conflicting factors may appear in a single case. All may be relevant and yet no one of them conclusive. All factors must be weighed together.

Legal Factors Outlined

Contractual Provisions. In the primary contract on a very large project, there may be a specific provision that the parties intend an independent contractor relationship, reciting the obligation of the builder as to torts, taxes and social welfare legislation. Even this specific provision may be voided as being against public policy if the subcontracting organization is connivingly subdivided so minutely as to keep each working unit under eight men, thus avoiding unemployment and workmen's compensation taxes.

A Recognized Business. A cook uses his food, cook trucks, equipment, material and assistants to feed a highway contractor's crew, charging each man two dollars a day. The cook is an independent contractor. Similarly, a builder who transports materials, supplies, and equipment in a common carrier, such as a truck, from Georgia to Ohio, or who removes rubbish from a construction job, is also classified as an independent contractor.

Work requiring a high degree of skill indicates that the owner or client is only interested in the result, not the means or methods of accomplishment. Illustrations of this are the professional welder, the mining engineer, and the professional well shooter. Each of these men may be an independent contractor, but a "handy man" would be an employee, since he is not practicing a specialized occupation or business.

The Time Element. The casual testing or repairing of equipment by a specialist might be independent contracting, but the full-time occupation of firing and repairing a group of apartment heating plants would appear to be the work of an employee. From these examples it may be concluded that the longer the duration of the relationship, and the more repetitious the occupation, the more probable it is that the worker is an employee rather than an independent contractor.

The Method of Payment. A wage of $2.60 per hour would indicate an employee, while a lump-sum price of $100,000 for a finished building would probably indicate an independent contractor. Cost plus percentage, cost plus fixed fee, cost plus adjustable fee or unit prices are characteristic of the independent contractor relationship. But the unit price is not conclusive, since employees may be paid on a piece-work basis, such as $70.00 per thousand for laying up brick.

Joint Financing. A landowner and a small builder might jointly undertake the construction of one or more houses, the profits after all costs to be divided equally between them. In this case the builder would not be considered an employee of the landowner, and if he were injured the landowner would not be liable. The relationship would be a partnership.

Ownership of Tools. An independent contractor generally furnishes all tools, materials, equipment, supplies, and the working organization, whereas an employee normally furnishes only his own small tools. Confusion arises where other factors indicate that a workman is an independent contractor, although he uses the trucks and tools of the employer. On the other hand a driver may be an employee and yet use his own truck, being paid by the load. This is particularly true where the worker's truck has been painted with the employer's name.

Control of method of work. A landowner might assemble a crew of carpenters, electricians and bricklayers, and proceed to erect a building. He then has control over the means and methods of work. He is the boss of his employees, and in general has the authority to hire, direct, pay and lay them off. On the other hand, an owner might contract with a builder to do the job. The builder then is an independent contractor. He is responsible for the result, and he himself has control of the means of operation, through the detailed instructions which he gives to the workmen.

The status of an independent contractor is not altered when the owner employs engineering inspectors to observe the quality and quantity of the work, in accordance with the specifications.

Of course, if the engineering inspectors should usurp the discretionary power of the independent contractor, then the owner-contractor relationship changes to the master-servant relationship. The owner becomes responsible for damages or injuries proximately caused by the engineer's usurpation of the discretionary power of the independent contractor. Similarly, if the contract specifications are so strict that the contractor does not have freedom to select the means and methods of work, the owner may find himself liable for the resulting damages.

ENGINEERS' NOTEBOOK

Inexpensive fluid polariscope built at Lehigh University

M. B. McPHERSON and R. E. NECE, Junior Members, ASCE

Assistant Professor of Civil Engineering and Instructor in Civil Engineering, Respectively, Lehigh University, Bethlehem, Pa.

A FLUID POLARISCOPE, built early in 1950 at the Hydraulic Laboratory of Lehigh University, has been successfully employed as a teaching aid to demonstrate fluid flow.

The fluid polariscope is analagous to a photoelastic stress analyzer. Polarized light, passing through a moving, optically active suspension, gives rise to bands of color resulting from the shear stresses within the fluid. The separate stationary bands of color describe the flow pattern, since each color is associated with a given degree of stress, and therefore a corresponding velocity change. Zones of stagnation and separation, as well as the flow path at a point, are clearly discernible.

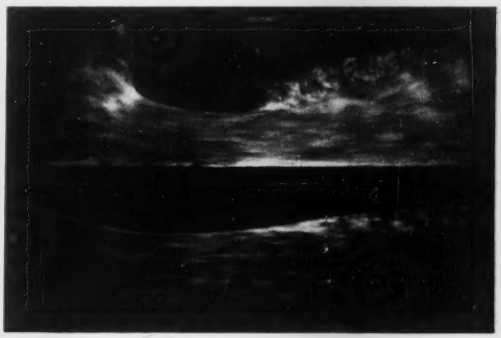
The use of the fluid polariscope as a demonstration unit in university laboratories is not new. But whereas the usual cost of materials to build a unit for qualitative demonstration runs to $200 or $300, the simple and versatile Lehigh unit (Fig. 1) was built at a cost of only $80 for materials.

This apparatus provides an excellent visualization of two-dimensional flow. The test sections can be arranged to illustrate flow through an orifice, venturi throat, sluice gate or nozzle, and flow around an airfoil or a cylinder. The hydraulic jump and flow over a spillway can also be demonstrated effectively. The flow panel, which contains three test sections, can be removed and replaced with another panel in a few minutes.

A vivid color pattern is obtained only if the optical system includes two polarizer plates and two quarter-wave plates. The quarter-wave plates alone (of 6.5-in. diameter) represent slightly over 40 percent of the total cost of materials for the apparatus. A substantial saving resulted from using polaroid film for the polarizer plates.

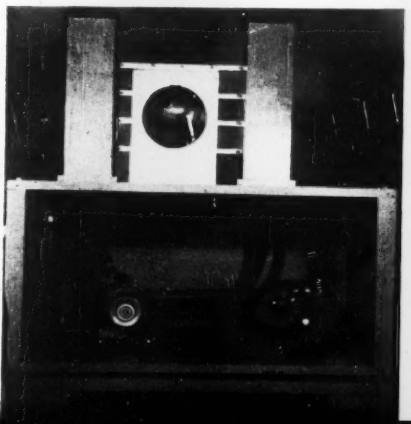
The optically active suspension is made from a special white Hector bentonite mined in California. To obtain a satisfactory suspension, a carefully prepared emulsion of the raw bentonite should be centrifuged with a resultant maximum equivalent spherical particle size of about one-half micron diameter.

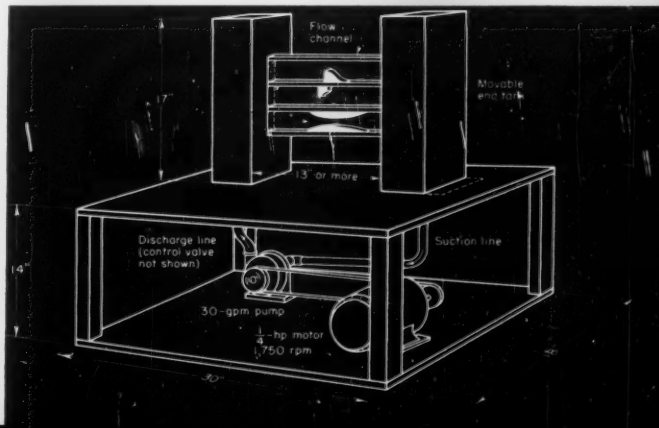
(This article is a résumé of a paper issued at the Middle Atlantic Section meeting of the ASEE. Copies of the complete paper may be obtained from the authors at the Fritz Engineering Laboratory, Department of Civil Engineering and Mechanics, Lehigh University, for 25 cents each.)



SLUICE GATE contraction and venturi throat simulated in Lehigh University fluid polariscope show general flow lines and discontinuity surfaces even in black and white photograph (taken at 1/200 sec by K. Harpel). Note hydraulic jump at upper right. Upper and lower parts of photo were spliced from selected negatives.

FIG. 1. PERSPECTIVE DRAWING (below, right) gives dimensions of polariscope built for Lehigh University's Hydraulic Laboratory at total cost of $80 for materials. Note spillway, sluice gate and venturi throat. Optical plates and plate holder are not shown in drawing but appear in photograph at left below.





Simple formula solves all higher-degree equations

D. B. STEINMAN, M. ASCE, Consulting Engineer, New York, N. Y.

INTEREST IN short-cut methods for solving cubic and higher equations and roots is considerable, judging from the many letters received by the writer in connection with his article in the June 1950 issue (page 41) presenting his algorithm or shortcut for this purpose. The method was further explained in his letter to the editor in the September issue (page 48). Because of this widespread interest, another method has been devised by the writer for solving the same problems and is here presented.

Given any algebraic equation

$$mx^n = ax^{n-1} + bx^{n-2} + cx^{n-3} + dx^{n-4} + \ldots \quad (1)$$

Then for any approximate trial root x_0, a close approximation to the exact root is given by

$$x_1 = \frac{a + \dfrac{2b}{x_0} + \dfrac{3c}{x_0^2} + \dfrac{4d}{x_0^3} + \ldots}{m + \dfrac{b}{x_0^2} + \dfrac{2c}{x_0^3} + \dfrac{3d}{x_0^4} + \ldots} \quad (2)$$

By repeating this operation, the solution can be carried to any desired degree of precision. For engineering design purposes, a single application of the formula will usually suffice.

Equation 2 is a universal formula, with no exceptions. It will generally yield speedier convergence than any other known method. It is directly applicable to each real root of an equation. No transformations of the equations to supply missing terms or to reduce the roots are required. Its simplicity of application is illustrated by the following examples.

Example 1: $x^2 = 3x - 0.5$; $x_0 = 3$.

$$x_1 = \frac{3 - \dfrac{1}{3}}{1 - \dfrac{0.5}{9}} = \frac{8(3)}{8.5} = 2.823$$

Example 2: $x^3 = 3x^2 + 4x - 1$; $x_0 = 4$.

$$x_1 = \frac{3 + \dfrac{8}{4} - \dfrac{3}{16}}{1 + \dfrac{4}{16} - \dfrac{2}{64}} = \frac{77(4)}{78} = 3.949$$

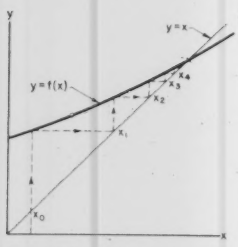


FIG. 1(*a*). Staircase iteration.

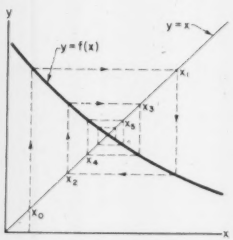


FIG. 1(*b*). Spiral iteration.

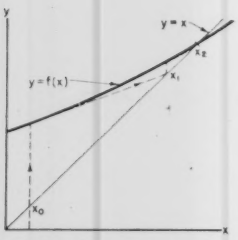


FIG. 2(*a*). Tangent convergence.

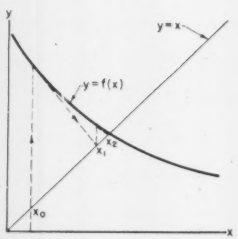


FIG. 2(*b*). Tangent convergence.

Example 3: $x^4 = 5x^3 + 2$; $x_0 = 5$.

$$x_1 = \frac{5 + \dfrac{8}{125}}{1 + \dfrac{6}{625}} = \frac{633(5)}{631} = 5.016$$

Example 4: $x^5 = 10x^4 + x^3 + 2x^2 + 3x + 4$; $x_0 = 10$.

$$x_1 = \frac{10 + \dfrac{2}{10} + \dfrac{6}{100} + \dfrac{12}{1000} + \dfrac{20}{10000}}{1 + \dfrac{1}{100} + \dfrac{4}{1000} + \dfrac{9}{10000} + \dfrac{16}{100000}}$$

$$= \frac{10.274}{1.01506} = 10.1216$$

Example 5 (cube root): $x^3 = 67$; $x_0 = 4$.

$$x_1 = \frac{0 + 201/16}{1 + 134/64} = \frac{201(4)}{198} = 4.061$$

In each of the foregoing numerical examples, the first trial gives the answer correctly to the number of significant figures shown. The following example illustrates the powerful convergence of the method:

Example 6: $2x^3 = 9x^2 + 10x - 12$. (One root, $x = -1.5$) $x_0 = 5$.

$$x_1 = \frac{9 + \dfrac{20}{5} - \dfrac{36}{25}}{2 + \dfrac{10}{25} - \dfrac{24}{125}} = 5.236$$

$x_0 = 5.236$, $x_1 = 5.2360679775$ (11 significant digits)

The next substitution would yield x to 28 significant figures.

To find the other root, $x_0 = 0.8$

$$x_1 = \frac{9 + \dfrac{20}{0.8} - \dfrac{36}{0.64}}{2 + \dfrac{10}{0.64} - \dfrac{24}{0.512}} = 0.76$$

$x_0 = 0.76$, $x_1 = 0.7639$
$x_0 = 0.7639$, $x_1 = 0.76393202$
$x_0 = 0.76393202$,
$x_1 = 0.7639320225002103$ (16 significant digits)

The next substitution would yield x to 32 significant figures. The sum of the three roots is $\frac{a}{m} = \frac{9}{2}$, and their product is $\frac{c}{m} = \frac{-12}{2}$.

The foregoing method is directly applicable to negative and fractional roots. In some cases of small fractional roots, it may be desirable (though not necessary) to reverse the equation and to solve for $1/x$.

Example 7: $4x^3 = 18x^2 - 20x + 3$. (One root, $x = 1.5$)

$$\text{Let } z = \frac{1}{x}$$

$3z^3 = 20z^2 - 18z + 4$ (reversed equation)

$$z_0 = 6$$

$$x_1 = \frac{1}{z_1}$$

$$= \frac{3 - \frac{18}{36} + \frac{8}{216}}{20 - \frac{36}{6} + \frac{12}{36}} = \frac{548}{516(6)} = 0.1770$$

In applying Eq. 2, the numerator and the denominator may be conveniently evaluated by synthetic division.

Example 8: $8x^3 = 20x^2 - 4x + 1$; $x_0 = 2.5$.

2.5)	20	−8	3	0
		50	105	270
	20	42	108	270

2.5)	8	0	−4	2
		20	50	115
	8	20	46	117

$$x_1 = \frac{270}{117} = 2.308$$

Derivation of the Formula

The philosophy and the derivation of the method represented by Eq. 2 are illustrated in Figs. 1 and 2. The given Eq. 1 may be written:

$$x = f(x)$$

$$= \frac{1}{m}\left(a + \frac{b}{x} + \frac{c}{x^2} + \frac{d}{x^3} + \ldots\right) \quad (3)$$

The intersection of $y = f(x)$ and $y = x$ (Figs. 1 and 2) will give the required root. The conventional methods of approach by successive substitution are represented by "staircase iteration" (Fig. 1*a*) or "spiral iteration" (Fig. 1*b*); and if $|f'(x)| > 1$, the iteration becomes a "divergent staircase" or a "divergent spiral" and the corresponding method fails. The writer's formula (Eq. 2) corresponds identically to Figs. 2(a) and 2(b), in which the conventional iteration methods are replaced by "tangent convergence," yielding a positive and more rapid approach to the exact root.

The writer's formula (Eq. 2) also corresponds identically to—and may be derived by—the application of Newton's tangent method to Eq. 3, written in the form,

$$y = f(x)$$

$$= x - \frac{1}{m}\left(a + \frac{b}{x} + \frac{c}{x^2} + \ldots\right) \quad (4)$$

Eq. 4 may be described as a "linearized" form of the given Eq. 1. The advantage of using the "linearized equation" (Eq. 4) is that its graph is virtually a straight line in the vicinity of the root, so that the higher derivatives become negligible and the tangent convergence (corresponding to the first derivative) comes very close to the exact root. The application of Newton's tangent method, in the form,

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

to Eq. 4 yields the writer's formula, Eq. 2.

Formula for Roots of Numbers

A further extension of the writer's device of using a "linearized equation" yields a very simple formula for finding any specified roots of given numbers. Given,

$$x^n = N \quad (5)$$

where n may have any value, including fractions. For any specified trial root x_0, let

$$R = N - x_0^n; \quad S = N + x_0^n$$

Then a remarkably close approximation to the exact root is given by the formula,

$$\frac{x_1}{x_0} = \frac{n\,S + R}{n\,S - R} \quad (6)$$

This simple formula gives closer convergence than any other known method of comparable simplicity and generality. It is derived by applying Newton's tangent method to

$$f(x) = x^{(n+1)/2} - Nx^{-(n-1)/2} = 0 \quad (7)$$

which is the "linearized" form of Eq. 5. For Eq. 7, the second derivative $f''(x)$ is zero at $f(x) = 0$, so that the graph is virtually a straight line in the proximity of the root. Consequently Eq. 6 yields very close convergence, equal to that attainable by including the second derivative in convergence formulas. For engineering design purposes, a single application of Eq. 6 will ordinarily suffice.

Example 9: $x^2 = 152$

$$x_0 = 12) \quad \begin{array}{r} 152 \\ 144 \end{array}$$

$$R = 8, S = 296$$

$$\frac{x_1}{12} = \frac{2(296) + 8}{2(296) - 8} = 1 + \frac{2}{73}$$

$$x_1 = 12.3288$$

Example 10: $x^3 = 121$

$$x_0 = 5) \quad \begin{array}{r} 121 \\ 125 \end{array}$$

$$R = -4, S = 246$$

$$\frac{x_1}{5} = \frac{3(246) - 4}{3(246) + 4} = 1 - \frac{4}{371}$$

$$x_1 = 4.9461$$

Example 11: $x^7 = 2523$

$$x_0 = 3) \quad \begin{array}{r} 2523 \\ 2187 \end{array}$$

$$R = 336, S = 4710$$

$$\frac{x_1}{3} = 1 + \frac{2(336)}{7(4710) - 336} = 1 + \frac{16}{777}$$

$$x_1 = 3.0618\ (3.0619)$$

Example 12: $x^{4/3} = 85$

$$x_0 = 27) \quad \begin{array}{r} 85 \\ 81 \end{array}$$

$$R = 4, S = 166$$

$$\frac{x_1}{27} = 1 + \frac{2(4)}{\frac{4}{3}(166) - 4} = 1 + \frac{6}{163}$$

$$x_1 = 27.994$$

In submitting his formula solutions (Eqs. 2 and 6), the writer invites comparison with any known methods.

THE READERS WRITE

Economy of Constant-Angle Arch Dam Depends on Site Conditions

TO THE EDITOR: In J. J. Polivka's letter in the November 1950 issue, entitled "Large Savings Estimated from Constant-Angle Dam Design," the implication is that a constant-angle arch dam can always be substituted for a concrete gravity dam at a saving of one-third the cost of the gravity dam. This is by no means true. The amount of concrete saved will vary with the site. In fact, the writer has investigated sites suitable for a concrete gravity dam which would require more concrete for an arch than for a gravity section. In addition, the unit cost of concrete would be slightly greater because of increased form costs.

The reason for the decrease in the use of the constant-angle arch dam, in the writer's opinion, is simply that most of the dam sites suitable for arch dams, at least in the United States, have been used.

In the past 12 years the writer has been involved, in various capacities, on the investigation and design of 23 proposed dams. After careful investigation and comparative cost estimates of the various types of dams suitable for each site, a concrete arch section was chosen for one site, concrete gravity sections for two sites, concrete gravity and earth sections for two, and earth sections with relatively small amounts of concrete for outlet works and spillways for 18 sites. This illustrates the fact that, for present-day conditions, there are few sites suitable or economical for arch dams.

A listing of storage capacities for the dams in Mr. Polivka's Table I, on page 45 of the November issue, would have been informative. The best measure of the reasonableness of the cost of a dam is the cost per acre-foot of storage, except for pure diversion dams. There are many sites where a high arch dam could be constructed very cheaply; however, because this type of terrain usually yields small storage capacity, the cost per acre-foot is still high. For example, the Pacoima Dam mentioned by Mr. Polivka as being 375 ft high has a storage capacity of only 5,900 acre-ft and a cost of $2,524,000 as reported by the State of California in its publication, *Dams Under Jurisdiction of the State of California* (July 1, 1941), or a cost of $438 per acre-ft at the time of construction, or approximately $1,080 per acre-ft at present-day prices.

In contrast, the Wolf Creek Dam on the Cumberland River in Kentucky, an earth fill dam with concrete gravity spillway, is only about 215 ft high but has a storage capacity of 6,089,000 acre-ft, at a present-day cost of about $24,000,000 for the dam only, excluding power facilities and right-of-way and clearing costs, which is a cost of about $4 per acre-ft.

HORACE A. JOHNSON, M. ASCE
Sacramento, Calif.

Elimination of Cross Connections Requires Continuous Effort

TO THE EDITOR: Cross connections are a potential danger in every water system, but with continuous effort they can be almost entirely eliminated. I say "almost," because we can never completely control plumbing repairs done by the ever-present handyman, who knows nothing of the principles of engineering.

In the course of the cross-connection elimination program in force in Seattle, Wash., for the past five years, we have broken 3,438 connections capable of contaminating the potable water supply by back siphonage. Back siphonage can be caused by negative pressure either in the building or in the city water main. Most cross connections can be eliminated simply by rearranging the piping.

We have not accepted a movable-part vacuum breaker on any one of these cross connections, but have always asked for a definite air gap. This air gap must be an unrestricted opening through which the water flows, and it must be at least twice the diameter of the pipe discharging the water. In only a very few cases has it been impossible to adopt this method. In these cases we have permitted the installation of an antisiphon loop, the top of which must be 34 ft above the highest point of use. This alternative has been permitted only after making sure that this loop would never be connected to any equipment or fixtures that might cause water to flow back into the potable supply.

The following case is cited to illustrate the danger of vacuum breakers with movable parts. A certain vacuum breaker, a complicated mechanical device, was installed by a customer just inside his property line on the service main. It failed to operate, and the entire potable water system of one of the largest marine docks in the world became so badly salted with bay water that it had to be drained and sterilized before it could be safely used. All this occurred after someone forgot to close a valve between the salt-water fire-protection system and the fresh-water line while a ship's potable water tanks were being filled. We were not notified until it was too late to tell whether any of this water had been forced back into our distribution lines. This vacuum breaker has been approved by a neighboring western state.

Why do not manufacturers develop a venturi-type vacuum breaker that has no moving parts and will need no mechanical attention? A vacuum breaker of this type has been designed and tested by a large dishwasher manufacturer but to my knowledge has not yet been put on the market.

Manufacturers can put out products so designed that they will meet our specifications without the need for attaching any kind of vacuum breaker. When the automatic washing machine was first introduced it had a direct connection to the tub. Now all manufacturers have installed an air gap. The flushometer toilet used in almost all public buildings might contaminate the water main through back siphonage if it should become plugged up at the same time that the supply main had a negative pressure. One manufacturer has a product that could, with slight changes be made safe, as it would have the water inlet at the back, above the free overflow line of the bowl.

In many of the larger industries where changes have been required to prevent back siphonage, owners have reaped benefits which more than covered the cost of the required changes. One company had several large water-cooled air compressors, from which used water was discharged directly into the sewer. Right next to the compressors, on the other side of a thin brick-tile wall, was the boiler room containing two large high-pressure boilers. These boilers were fed from the city water supply through a closed make-up tank, where a boiler compound might be added. This arrangement was potentially bad as the boiler working pressure was very near the pressure in the city water main.

We asked that an air gap be installed in the compressor discharge line and another in the boiler make-up line. At the same time we suggested that the compressors' discharge line be run into the boiler room and into the make-up tank through an air gap. This was done

and the city water supply was then cut off from the make-up tank. The company now gets its boiler feedwater from the compressors. This water, which formerly was wasted down the sewer, is 15 to 20 deg warmer than that formerly injected into the boilers. The final result is a substantial saving in boiler feedwater and an even greater saving in fuel-oil consumption for the boilers.

Our program for the elimination of cross connections has been very successful. We have had the complete cooperation of the public in our efforts to deliver a water of good bacteriological quality.

R. FOWLER
Assistant Sanitary Engr.
Seattle, Wash. *Seattle Water Dept.*

Jarvis-Myers Formula Recommended for Bridge Waterway Areas

TO THE EDITOR: My interest in bridge and culvert areas dates back to 1906 when I had a part in the design of culverts for New York's Catskill Aqueduct. For this reason, the article by Robert B. Yule in the October issue attracted my attention.

Following a flash flood that caused considerable local damage at Downsville, N. Y., where construction of the new dam for New York City's water supply is now in progress, a summary of those earlier Catskill Aqueduct studies was published in the July 1, 1942, issue of the *Delaware Water Supply News*. Maximum flood flows for drainage areas up to 350 sq miles in the northeastern United States were spotted on a diagram accompanying this article. This diagram clearly showed the inadequacy of the early formulas for flood flows, and demonstrated the value of the modified Myers formula, discussed below.

The original formula proposed by E. T. D. Myers, M. ASCE, a Virginia railway engineer about 1879, was for determining the size of culverts. In this, the culvert area in square feet should equal $C\sqrt{A}$, in which C was a coefficient varying from 1 to 4, and A was the drainage area in acres.

Recognizing the simplicity of this formula, Clarence S. Jarvis, M. ASCE, in his paper, "Flood Flow Characteristics" (ASCE TRANSACTIONS, 1926, p. 994) proposed to modify it to give the peak flow instead of the culvert area. In his modified formula, $Q = 10{,}000\ P\sqrt{M}$, where Q is the total flow in cfs, P a coefficient normally less than 1, usually expressed in percent; and M, the drainage area in square miles. Mr. Jarvis, now a consulting engineer in Salt Lake City, Utah, has called this simple but useful formula the modified Myers formula, and others have designated it the Jarvis formula. In recognition of its dual source, I venture to call it the Jarvis-Myers formula. The history of this formula was first given in an article in *Water Works Engineering* for July 1948, page 646.

For ready comparison of different sized watersheds, it is best to put the Jarvis-Myers formula on a per-square-mile basis by dividing both sides of the equation by M, when it becomes $q = 10{,}000\ P\sqrt{M}$, in which q is the discharge in cfs per square mile.

Percentage ratings for the Jarvis-Myers formula, based on observed stream-flow records all over the country, are given by Mr. Jarvis in his chapter in *Hydrology*, edited by the late Oscar E. Meinzer and sponsored in 1942 by the National Research Council (reprinted in 1949 by Dover Publications, Inc., New York, N.Y.). The practical utility of this formula is illustrated by the fact that the U. S. Geological Survey in recent years has been placing guide lines on its flood-flow diagrams to show pertinent percentages in the formula. Such a diagram is given in Fig. 1.

But what does all this have to do with the waterway formula presented by Mr. Yule in the October issue? Is there anything wrong with that formula?

The answer is that presumably the Yule formula is entirely satisfactory for anyone who, like Mr. Yule, is familiar with Indiana conditions. However, it is just one more formula, consisting of a coefficient times the nth power of the drainage area. Similar formulas have been proposed by various authorities, including the late Allen Hazen, M. ASCE, assigning values to n ranging all the way from 0.3 to 0.8, as pointed out in *Engineering for Dams*, by Creager, Justin and Hinds (Vol. 1, Chapter 5, p. 125). Whether a value of 2/3 is adopted for n, as in Mr. Yule's formula, or a value of 1/2, as used by Mr. Myers 70 years ago, seems to be merely a matter of individual preference, the coefficient being varied up or down to meet a given set of conditions.

The writer's preference has been to use the formula that apparently has had the widest general acceptance, particularly since the square root of the drainage area is much easier to calculate than the two-thirds power. Furthermore, the writer much prefers to use a formula that gives the answer in cubic feet per square mile rather than as the area of a waterway. Incidentally, the steepness of the stream bed makes all the difference in the world in the available velocity and therefore the flood-carrying capacity of a waterway, so that a designer needs to know more than just the area of the watershed.

In passing, it may be noted that Mr. Yule refers to the drainage area in square miles, although his diagram shows it in acres, which is presumably the correct designation for his chart.

I personally have found the Jarvis-Myers formula by far the most readily usable for peak flood flows yet devised. Naturally, it does not apply to areas like Mt. Waialeale in Hawaii, where the rainfall averages 440 in. a year, but for drainage areas of 25,000 sq miles or less, it is a useful tool. For areas larger than that, it probably gives results somewhat too high, but few of us are designing spillways or culverts for such large watersheds.

F. B. MARSH, M. ASCE
White Plains, N.Y.

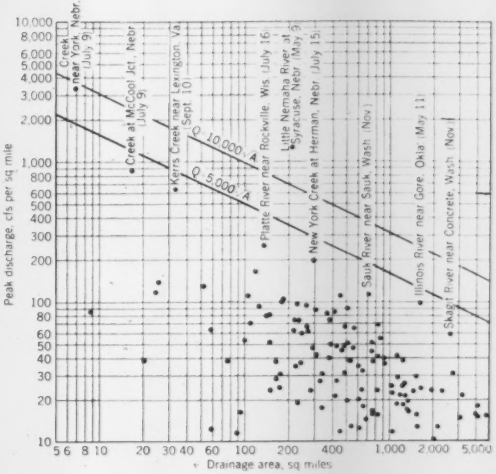

Peak discharge, cfs per sq mile
Drainage area, sq miles
Q = 10,000 √A
Q = 5,000 √A
Creek near York, Nebr. (July 9)
Creek at McCool Jct., Nebr. (July 9)
Korrs Creek near Lexington, Va. (Sept. 10)
Platte River near Rockville, Wis. (July 16)
Little Nemaha River at Syracuse, Nebr. (May 9)
New York Creek at Herman, Nebr. (July 15)
Sauk River near Sauk, Wash. (Nov.)
Illinois River near Gore, Okla. (May 11)
Skagit River near Concrete, Wash. (Nov.)

FIG. 1. FLOOD DISCHARGES in relation to drainage area are given for water year ending September 30, 1950, in chart from *Water Resources Review* of U.S. Geological Survey. Note that guide lines give percentages in terms of Jarvis-Myers formula.

SOCIETY NEWS

Engineers Joint Council Acts to Conserve Engineering Manpower

An aggressive three-point program for stimulating conservation of engineering manpower was outlined by the Engineering Manpower Commission of Engineers Joint Council at the January 19 meeting of EJC in New York. The program, which will involve an annual expenditure of $100,000, is designed (1) to overcome future shortages of engineering graduates by increasing the enrollment in engineering schools; (2) to assure better utilization of present engineering manpower by alerting employers to the need for better utilization caused by the impending shortage; and (3) to assist governmental bodies in the conservation of engineering manpower by acting as consultant to them.

Appointed in October at the request of the National Security Resources Board, the 20-man Engineering Manpower Commission, under the temporary chairmanship of E. G. Bailey, was charged with a study of the engineering manpower situation. The aim of the study was to prevent a recurrence of the World War II situation, in which scientific and engineering skills were not used for the best interests of the country, and to devise a way to relieve the present critical shortage of engineers. As revealed at the January 19 meeting and noted in previous issues of CIVIL ENGINEERING, only half enough (30,000) freshmen entered engineering schools last September to produce the indicated annual need for 30,000 engineering graduates.

In its report to the NSRB on December 20, the Commission recommended legislation to provide for: (1) Selective Service registration of every man up to age 70, who is engaged in one of the critical fields of engineering or is in training for such a field, and (2) establishment of a National Engineering Personnel Board to classify registrants, and select those with the proper skills for military, civil defense, and industrial allocation.

The over-all responsibility placed on its Manpower Commission by EJC is to develop policies and procedures for the purpose of securing the most effective use of engineering skills and experience in industry and government (both civilian and military) during the emergency, and to take necessary steps within the scope of EJC to put those policies and procedures into practice. The three-point program, recommended by the group and approved by EJC, is based on the realization that achievement of its objectives will involve improving several facets of public knowledge of the basic importance of engineering skill and experience.

Thus the broad three-point program proposes a counselling service to high school officials, students, and their parents. It calls for alerting industrial organizations to the need for developing policies for themselves, under which engineers will be used only on jobs requiring engineering training, and to the need for making their manpower situation known to appropriate government agencies. It would urge government to insure the protection of necessary engineering personnel in critical industrial positions, and to develop a policy within the armed services of assigning engineers to jobs requiring engineering training and experience.

Other EJC Accomplishments in 1950

A second major accomplishment of EJC during 1950 was the completion of a survey of 63,689 selected engineering personnel for the national military establishment. These records were forwarded to the National Security Resources Board in Washington in the fall of 1950.

In June 1950 the EJC Water Policy Panel (established in 1949) issued a comprehensive report, *A Statement of Desirable Policy with Respect to the Conservation, Development, and Use of the National Water Resources*. The report was made available to the President's Water Resources Policy Commission, which in December issued its general report, *A Water Policy for the American People*.

"In another direction EJC has been watchful of the profession's interest in governmental activities," EJC President L. E. Young told the group. Through its Science-Legislation Panel it has been instrumental in getting representation for engineers on the National Science Foundation Board. EJC urged the appointment of qualified engineers to the personnel of the Board, which was set up by President Truman in May 1950. The personnel of the 24-member board, announced in December, includes three engineers from the list recommended by EJC. It will be recalled that the original legislation omitted provision for engineering research until the Science Legislation Panel made presentations to Committees of Congress.

The next meeting of EJC is scheduled for March 16, 1951.

1950 Index Available

MATERIAL APPEARING IN the twelve issues of "Civil Engineering" from January through December 1950, is included in the index to Volume 20, now available without charge on request to Society Headquarters for those desirous of incorporating it in their 1950 bound volumes.

Single copies of the index are sent to all subscribing libraries. Extra copies are available on request.

Vannevar Bush Awarded 1951 John Fritz Medal

The John Fritz Medal for 1951 was awarded to Dr. Vannevar Bush, president of the Carnegie Institution, Washington, at the winter meeting of the American Institute of Electrical Engineers, held in New York City, January 22–26. A joint award of the four Founder Societies, the medal was established in 1902 in honor of John Fritz, industrialist and recipient of the first award. Subsequent winners have included George Westinghouse, Alexander Graham Bell, Thomas A. Edison, and ASCE Honorary Members Herbert Hoover and Charles F. Kettering.

Engineer and educator of note, Dr. Bush was professor of electric power transmission at Massachusetts Institute of Technology from 1923 to 1932 and vice-president and dean of engineering at Carnegie Institution before becoming president in 1939. During the war he served as chairman of the National Defense Research Committee, director of the Office of Scientific Research Development, and chairman of the Joint Research and Development Board. He is cited for "outstanding scientific contributions to his country and to his fellowmen."

Measures to Reduce Earthquake Damage Reported by Seattle Section Earthquake Committee

Recommendations for the reduction of property damage and public hazards due to earthquakes are made in a recently issued report of the Earthquake Committee of the Seattle Section. Appointed in June 1949 to investigate damage caused by the Pacific Northwest earthquake of April 13, 1949, in particular, and earthquakes in general, the committee has carefully analyzed damage to structures and made corrective recommendations. Pointing out that the "Pacific Northwest is constantly subject to future devastating earthquakes," the committee states that its report was prepared "with a feeling of responsibility" and as a necessary public service. Had the quake lasted a little longer, it warns, there would probably have been 5,000 casualties and property damage of $100 million in the Pacific Northwest.

Functioning as a member committee of the Northwest Conference of Earthquake Committees of ASCE, the committee consists of Harlan H. Edwards, author-chairman, Cecil C. Arnold, vice-chairman, S. Charles Dearstyne, Elmer E. Gunnette, Homer M. Hadley, William Enkeboll, Thomas Campbell, and Holger Mittet. Prof. A. L. Miller, of the University of Washington, is chairman of the Northwest Conference of Earthquake Committees.

Property damage of more than $15,000,000 occurred and seven lives were lost in the quake. Major damage occurred in the low, soft land areas extending from Seattle southward to Longview, including the cities of Puyallup, Tacoma, Olympia, Centralia, and Chehalis. Occasional damage occurred to structures on hard ground. "As in all previous earthquakes," the report notes, "the predominant damage occurred to masonry buildings of poor design, built with weak, chalky lime mortar, which was characteristic of the early-1900's, or were of inferior materials and poor workmanship."

In soft water-bearing localities, according to the report, earthquake vibration consolidated alluvial and artificially filled land so that some areas settled as much as a foot. "In this consolidation, earth particles moved closer to each other, releasing water that had been held within the pore spaces or intergranular areas in the soil. . . . This water escaped in small geysers, rising to heights of as much as 3 ft, carrying with it fine sand which filled basements, built small surface craters, etc. Zones of compression or tension were created within the soil, forcing up basement floors as much as 16 in. in some areas, pulling apart electric conduits as much as a foot, and breaking water and sewer lines.

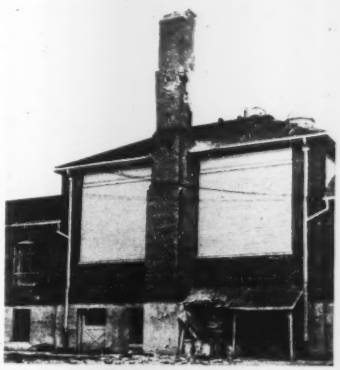
"Especially in these alluvial areas many buildings were damaged in ways which could be classified as (1) dangerous superficial damage such as fractured parapets and ornamentation, (2) costly superficial damage such as fractured partitions, walls, and windows, (3) dangerous structural damage such as collapsed walls and roofs, fractured columns and beams, etc., (4) potentially dangerous structural damage, such as cracked structural members sometimes concealed by surface veneers, and (5) potentially dangerous damage to utilities, such as displaced sewer and water lines with resulting minor fractures that tend toward future pollution, displaced electrical and communications lines that failed later on, etc.

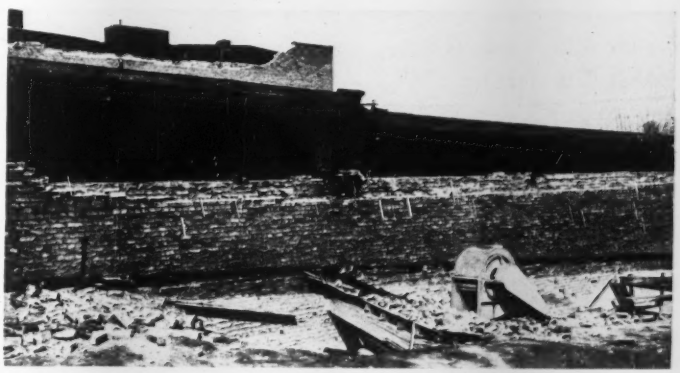
"Some old masonry structures with wood frame interiors suffered quick and heavy damage. The inadequacy of the lime mortar of early days was again demonstrated, while strong mortars and encircling reinforced concrete bond beams showed their worth. Poorly designed simple frame structures without ties failed, while well designed continuous frame structures suffered little, if any, damage. . . .

"Roofs and roof trusses not anchored to the structure slipped from their supports and crashed to or through the floors below. Many failures were due to the total lack of anchors or ties, and showed gross disregard for the basic principles of good construction.

"Reinforced concrete chimneys showed little, if any, damage. Where chimneys were of unreinforced brick or chimney block, all sizes failed in large numbers—sometimes causing severe damage to adjoining structures. Presence of flue lining seemed to make little difference in the character of failures noted. Some chimneys rotated as much as 45 deg at mortar joints above the roof line without toppling."

The report notes that school buildings suffered disproportionately greater damage than other structures and that heavy casualties would have occurred had they been occupied at the time of the quake. This is attributed to the fact that "ornamentation and monumental design seem to transcend structural safety as the first consideration in school design." Deploring the indifference on the part of many designers to the fact that seismic hazards exist, the report states that, "New schools, which are replacing some of those de-





AT PUYALLUP, WASH. (lower view), unbraced flexible wood roof construction without joist anchors or brick ties, creates havoc in structures adjoining old brick buildings. Photo at left shows unreinforced brick chimney on verge of crashing through roof of school at Chehalis, which was in session.

stroyed by the April 13 quake, still do not take into consideration the lessons taught by past disasters."

Concluding that the entire Pacific Northwest west of the Rocky Mountains, and particularly the area west of the Cascade Mountains, is a seismic area subject to strong-motion earthquakes, the report makes the following recommendations:

"1. That useless, superficial and dangerous ornamentation be deleted from plans or removed from structures.

"2. That basic design be such that rigid resisting units are provided where needed, that differential movement of various masses can be properly provided for and that torsional movement can be resisted or eliminated.

"3. That ultimate economy be considered in addition to safety. In the architectural and structural design, if advantageous, conventional heavy materials should be discarded for modern lightweights, particularly in the upper portions of the building.

"4. That the seismic design sections of the 1949 and succeeding editions of the Pacific Coast Uniform Building Code be adopted by all governing bodies and that a state organization be created to secure compliance in all areas not under the jurisdiction of city or county building departments.

"5. That the minimum seismic design factor in the above-mentioned code be determined for any area by the zone of earthquake probability established by the Coast and Geodetic Survey.

"6. That, due to the public hazards disclosed, legislation be enacted requiring potential earthquake hazards to be abated within a specified maximum time.

"7. That legislation be enacted requiring owners of structures used by the public or located along public ways to bear responsibility for damage to the property of others and for injury or loss of life occasioned by their structures or parts of them due to seismic disturbances."

President Howard Visits Kansas City Section

Retiring President Ernest E. Howard concluded his series of Presidential visits with Local Section groups with a meeting with his home Section, Kansas City, in January. There, as elsewhere before Society and Section groups during his year as President, Mr. Howard reiterated his faith in ASCE as a "strong, active, and growing force" for the betterment of the profession.

"Membership in the Society is still," he said, "and, I believe increasingly, regarded as evidence and recognition of accomplishment. The Society is respected for its high standards, and the members would never willingly see those standards lowered. The well-known blue seal is as always a mark of honor and distinction.

"The character of our membership is high, both personally and professionally. In every Local Section in every part of the country there are men of outstanding ability in the various professional fields, men who command the respect of all their fellow citizens, both within and without the profession.

"Inevitably as the Society grows in numbers, it faces new problems and conditions and must continually widen and increase its activities. These problems call for increase of income, not only to offset the shrunken purchasing power of the dollar but to provide for increased activities. I am confident that more funds will be provided and that the Society will move on to greater usefulness, not only to the benefit of the profession but to the benefit of society at large. Our purposes and ideals are high. As we grow more and more to achieve these high ideals, we grow in the respect of our fellowmen. If there is any trouble with our Code of Ethics and practice, it is not in the words but in our failure to live up to the ideals aspired to.

"We can and should be proud of our profession. We can and should be proud of our Society, and we can feel with assurance that both will continue to develop and prosper."

Mid-Continent Student Conference Meets at University of Arkansas

JOB OPPORTUNITIES FOR CIVIL ENGINEERS are discussed by panel of engineers representing various professions at Sixth Annual Conference of Student Chapters, held on University of Arkansas campus. Shown, left to right, are Col. George Schneider, of Little Rock District of Corps of Engineers; H. R. Conway, sanitary engineer for Arkansas State Board of Health; Eugene Bespalow, vice-president of Choctaw, Inc., Memphis Tenn.; Marion L. Crist, Little Rock consultant; and Alf Johnson, chief engineer of Arkansas State Highway Department. University of Oklahoma will be host to next conference and Tom Abernathy of Missouri School of Mines and Metallurgy, president. Retiring conference officers are Hal Faulconer, president, and K. W. Rippy, secretary-treasurer. Delegates were present from eight engineering colleges and universities in area.

California Conference of Local Sections Planned

The four California Sections of ASCE have scheduled their annual conference for May 3-5 in Yosemite National Park. Many California engineers are planning to attend what promises to be an interesting session.

The conference will open Thursday evening, May 3, with a session on Yosemite lore led by one of the park officials. Friday is set aside for technical and business sessions, with a banquet scheduled for the evening. A Student Chapter conference will follow on Saturday, May 5.

Included on the technical program are speakers of authority on West Coast engineering matters. These include Neil Petree, chairman of the Highway Committee for the California State Chamber of Commerce; S. T. Harding, Director of the Society and Berkeley consulting engineer; and N. A. Bowers, Pacific Coast Editor of *Engineering News-Record* for 36 years.

Convention headquarters will be the Ahwahnee, with quarters also available at Yosemite Lodge and Camp Curry. Interested ASCE member from outside California are cordially invited to attend. Reservations may be made by writing the Yosemite Park and Curry Co., Yosemite National Park, Calif.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative, ASCE

Building Construction Control Ordered

Further limitation of commercial construction by NPA order was the outstanding development of the month for the construction industry. Amended Order M-4, issued January 13, prohibits new starts on commercial building construction until February 15. Commencing on the latter date, licenses will be granted for buildings that further the defense efforts, are essential to the public safety or will alleviate hardship to a particular community. Structures affected include office and loft buildings, hotels and some warehouses. Application forms to obtain the necessary licenses are now available through offices of the Department of Commerce.

Immediately prior to the promulgation of this order, a Construction Industry Advisory Committee to the National Production Authority was established with five representatives of the design professions and eight construction representatives out of a total membership of twenty-nine. J. B. Converse, M. ASCE, of Mobile, Ala., represents the civil engineering field. The proposed order was discussed with the committee which expressed approval of its immediate promulgation. If the order is realistically administered, a sound purpose will be served but if handled arbitrarily much confusion can result.

Steel and Copper in Short Supply

This order was designed to save construction materials, particularly steel and copper. It is estimated that 1½ million tons of fabricated steel will be needed in the next two years in connection with the construction of new production facilities. While the supply of steel is short, new facilities should bring an ample supply by 1952.

Copper is in exceptionally short supply, and it seems that the available supply will soon have to be restricted to defense uses. The outlook for the next two years is poor. Large amounts of copper are needed in the construction of new aluminum and other plants. Even with the opening of marginal mines the outlook is poor. Order M-12, as amended, prohibits the use of copper in many items of builders hardware and building products such as roofing, drains, ornamental metal work and many types of pipes, as well as numerous appliances and consumer goods.

The general pattern and sequence of controls is illustrated by the actions taken on several of the most critical materials and on construction. The first step was the granting of DO Orders for high priority defense uses. That necessitated the limiting of civilian use to a certain percentage of the use last year. Then it becomes necessary to prohibit certain unessential uses entirely. Conservation orders and specifications control are the next step and then licensing. The ultimate step of course is a complete control of materials. Engineers and architects are urged to devise methods to conserve critical materials, particularly to use substitutes for steel and copper. New orders to conserve materials for the most urgent uses can be expected with increasing frequency. A recent NPA order establishes a new procedure for delivering over 300,000 tons of steel products monthly for the production of 10,000 freight cars per month.

DO ratings, top defense priority, are now available to procure accessories for production equipment for companies working on rated orders. DO ratings are also permissible for construction equipment to be used on overseas projects. Consideration is being given to putting urgently needed new productive facilities under the DO system.

Price Controls Announced

C. E. Wilson, Director of Defense Mobilization, recently stated that the power of law must be invoked "for allocation of materials, for prices, rents and wages—for whatever controls are necessary to prevent inflation, to promote production for defense and provide a fair distribution of commodities among all our citizens." Thus price controls were announced on January 27.

The President has said that we must have the capacity to produce 50,000 military planes per year and 35,000 tanks. That means a large increase in facilities, encouraged by such devices as government loans, rapid amortization and government contracts to take the output over a considerable period of time. New estimated defense expenditures and contract authorizations up to mid-1952 amount to more than $80 billion, in addition to sums for atomic energy and new productive facilities.

Defense Production Authority Set Up

Latest developments in controls organization include the setting up of a Defense Production Authority and the assignment of NPA Administrator Harrison as its Administrator. He takes over some of the controls powers previously assigned to the Commerce, Interior, and Agriculture Departments and the ICC. Presumably NPA will be placed directly under his control. The organization pattern seems fairly stable at top level, with Harrison in charge of production and Eric Johnston in charge of economic stabilization as the two top assistants to Mobilization Director Wilson.

D.C. Registration Board Ready

To obtain information and application forms for registration with the District of Columbia Engineering Registration law, address Leo H. Cleary, secretary-treasurer, D. C. Board of Registration for Professional Engineers, 1022 20th Street, N.W., Washington, D.C. Daniel C. Walser, M. ASCE, is chairman of the Board.

Civilian Defense at Local Levels

The Civil Defense bills were enacted into law on January 12 as "The Federal Civil Defense Act of 1950," P.L. 920—81st Congress. The provisions of the law are as stated in this column for January. An appropriation is expected to be made soon. Operations will be primarily at state and local level with the Federal Civil Defense Administration serving to coordinate activities and advise on basic principles. This work should be of great

ASCE MEMBERSHIP AS OF JANUARY 9, 1951

Members	7,767
Associate Members	10,015
Junior Members	15,485
Affiliates	67
Honorary Members	39
Fellows	1
Total	31,372
(January 9, 1950	27,824)

interest to Local Sections of ASCE. They should contact the Civil Defense Administrator of their locality and ascertain what engineers can do in this work.

Other Proposed Legislation Reviewed

Proposed legislation of interest includes a new housing bill involving $3 billion in FHA mortgage insurance. Authority is also proposed for federally financed housing and the provision of community facilities. Some question is raised as to whether this proposal is consistent with the action of the government in restricting building credit to prevent inflation.

H. J. Res. 100 proposes the appointment of a board of five eminent engineers outside of government to report on the Central Arizona Project and other matters relating to irrigation in the West.

H.R. 1731, recently passed by the House, provides for the renegotiation of government contracts as a means of recapturing excessive profits. It would apply to those doing over $100,000 in business with the government in any year.

Washington 25, D.C.
January 27, 1951

Metropolitan Juniors Queried on Engineering Education

Over 300 members of the Junior Branch of the Metropolitan Section described ways in which their college education was lacking in response to a recent Branch questionnaire seeking information on the subject. Results of the survey will be offered to the colleges represented and to engineer groups concerned with education.

In the returns stress is placed on practical courses, with construction (estimates, costs, plant and management) topping the list of courses needing greater emphasis. Others on this list are contracts and specifications, valuation and appraisal, economics, public speaking, report writing, foundations, reinforced concrete, business law, personnel and labor relations, drafting and surveying. The group as a whole feels it could have stood less of advanced mathematics, railroads, geodetic surveys, general chemistry, and advanced surveying.

Over 70 percent favor extension of engineering curricula beyond the customary four years to give a broader base for the humanities and more time for delving into engineering specialties.

On methods of presentation of material, it is the consensus that there should be more field trips and that information should be presented with emphasis on its practical application. Classroom instruction is criticized as having degenerated in some cases to "heavy note-taking sessions" with little student participation. Visual aids were suggested as one cure for the problem. To 41 percent of the group college extra-curricular activities have helped in some way since graduation.

Fuller information on the results of the questionnaire may be obtained from Robert K. Lockwood, secretary of the Junior Branch of the Metropolitan Section, 33 West 39th Street, New York 18, N.Y.

GLIMPSED AT RECENT ANNUAL MEETING of St. Louis Section are, left to right, incoming Section President John W. Hubler, professor of civil engineering at Washington University; Walter A. Heimbuecher, John W. Davis, and Hurieosco Austil, who received certificates of life membership; and outgoing Section President Malcolm Elliott, colonel, U. S. Army, retired. Guest of honor and principal speaker was Lachlan Macleay, president of Mississippi Valley Association. New Section officers, in addition to Professor Hubler, are Brice R. Smith, vice-president, and Henry M. Reitz, secretary-treasurer.

ECPD Annual Report for 1950 Available

Activities of the Engineers' Council for Professional Development toward improving the engineering profession and, through engineers, the general competence of the nation, are summarized in the Eighteenth Annual Report of the organization for 1950. Of the achievements of ECPD, the best known is the work of its Committee on Engineering Schools, which since 1935 has examined and accredited 656 engineering curricula in 142 engineering schools of the country. The list is included in the report.

Copies of the 1950 report and other ECPD publications may be obtained from the headquarters of the Engineers' Council for Professional Development, 29 West 39th Street, New York 18, N.Y. The report sells for 50 cents.

Submit Technical Papers Through ASCE Headquarters

All manuscripts of papers intended for use directly by the Society in its Proceedings Separates, rather than for presentation at technical meetings, are henceforth to be submitted through headquarters and not through the Technical Divisions concerned. Though the Divisions are offering material help in the processing of such papers under revised procedures effective a year ago, it is believed that both Divisions and authors will be helped by the more uniform procedure suggested.

Manuscripts will be recorded and acknowledged in the main office before being forwarded to the Divisions. Full details of technical publications procedure may be obtained from ASCE Headquarters.

Coming Local Section Events

Central Ohio—Meeting in the Chittenden Hotel, Columbus, February 15, at 6:15 p.m.

Cincinnati—Meeting in Cincinnati the first Wednesday of each month.

Colorado—Dinner meeting at the Democratic Club, Denver, the first Monday of each month.

Columbia—Meeting in Walla Walla, Wash., on February 8.

Florida—Meeting at the Seminole Hotel, Jacksonville, February 13, at 7 p.m.

Georgia—Luncheon meeting at the Atlanta Y.M.C.A., the first Friday of each month, at 12:30 p.m.

Illinois—Weekly luncheons every Friday at the Chicago Engineers Club, at 12 noon.

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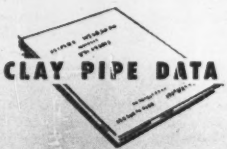

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Intermountain—Meeting in Salt Lake City on February 16.

Kansas—Meeting in Topeka, February 16, at 6:30 p.m.

Kansas City—Dinner meeting at the Wishbone, Kansas City, February 20, at 6:30 p.m.

Los Angeles—Dinner meeting at the Alexandria Hotel, Los Angeles, February 14, at 6:30 p.m., preceded by Junior Forum meeting at 6 p.m.

Maryland—Meeting at the Engineers Club of Baltimore, Baltimore, February 14, at 8 p.m., preceded by cocktails at 6:15 p.m and dinner at 7 p.m.

Metropolitan—Meeting in the Engineering Societies Building, New York City, February 21.

Miami—Meeting in Miami the first Thursday of each month.

Northwestern—Meeting in Minneapolis the first Monday of each month.

Oklahoma—Dinner meeting of the Oklahoma City Branch in the Y.W.C.A. Building, Oklahoma City, February 16, at 6:30 p.m. Meeting of the Tulsa Branch in the Chamber of Commerce Building, Tulsa, the first Monday of each month.

Philadelphia—Meeting at the Engineers Club, Philadelphia, on February 13. Meeting of the Delaware Sub-Section on February 20.

Sacramento—Regular luncheon meetings every Tuesday at the Elks Club, Sacramento, at 12:30 p.m.

Syracuse—Meeting in Syracuse on February 22.

Tacoma—Meeting in Tacoma on February 13.

Tennessee Valley—Dinner meeting of Knoxville Sub-Section at the S & W Cafeteria, Knoxville, February 14, at 6:15 p.m.

Texas—Luncheon meetings of Dallas Branch the first Monday of each month, at the Hotel Adolphus, at 12:15 p.m. Luncheon meetings of Fort Worth Branch at the Blackstone Hotel, February 12, at 12:15 p.m.

Toledo—Meeting at the Elks Club, Toledo, February 7, at 8 p.m., preceded by dinner at 6:30 p.m.

Virginia—Annual meeting at the Hotel Jefferson, Richmond, February 9; business session at 3:30 p.m. and dinner at 6:30 p.m.

Scheduled ASCE Conventions

WINTER CONVENTION
Houston, Tex., February 21–23
(Board of Direction meets February 19–20)

SUMMER CONVENTION
Louisville, Ky., June 13–15
(Board of Direction meets June 11–12)

ANNUAL CONVENTION
New York, N. Y., October 22–25

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Akron	Jan. 11	13	Business meeting with installation of S. Y. Symns, as president, and Howard Miller, as secretary-treasurer.
Buffalo	Dec. 19	36	Luncheon meeting with James N. DeSeria, Buffalo consultant, speaking on structural design of Dante Housing Project. Herbert F. Darling and John R. Campbell were elected president and secretary, respectively.
Central Illinois	Dec. 5	75	Joint meeting with University of Illinois Student Chapter. A. L. R. Sanders, chief engineer, Hazelet & Erdal, consulting engineers of Chicago, talked on Mississippi River Bridge at East St. Louis. Lawrence P. Murphy was elected president and Clyde E. Kesler, secretary.
Cincinnati	Dec. 6	58	J. M. Robertson, drainage engineer for the American Rolling Mill Co., Middletown, Ohio, discussed subsurface drainage.
	Jan. 3	26	E. J. Ruble, structural engineer, Association of American Railroads, Chicago, discussed the association's research program.
Cleveland	Dec. 15	...	Allen McKlimon, manager of sales development, Euclid Road Machinery Co., gave an illustrated talk on Garrison Dam.
	Jan. 13	...	Annual meeting with installation of Alfred D. Yanda, as president, and H. Bruce Baty, as secretary-treasurer. William G. Rose presented an illustrated speech entitled, "Cleveland Looks Forward."
Colorado	Dec. 14	71	Dinner meeting with Sam Hawkins, supervising engineer, Denver School District No. 1, outlining the city's school building program. Election of officers: W. H. Thoman, president, and Terry J. Owens, secretary-treasurer.
Connecticut	Dec. 4	55	Joint dinner meeting with Yale University Student Chapter. ASCE Director H. L. Blakeslee spoke on recent Society affairs. Arthur Beaulieu, director, Real Assets Division, State of Connecticut, discussed division activities.
Duluth	Nov. 24	...	Joint annual convention with the Northwest Federation of Student Engineers. ASCE Director Gordon H. Butler presented Certificate of Merit to Dick Booth, president of UMD Student Engineers' Club. The National Water Policy was discussed by Mr. Booth and Hibbert Hill, hydraulic engineer, Northern States Power Co., Minneapolis, Minn.
Florida	Nov.	...	John Miller, a member of the Florida State Board of Health, discussed the EJC report on the National Water Policy.
Georgia	Dec. 9	...	Annual meeting with election of Moses E. Cox as president. Afternoon technical session. William N. Carey, ASCE Executive Secretary, and Director Edmund Friedman, were guests at dinner meeting.
Illinois	Nov. 14	...	Joint meeting with Illinois Society of Professional Engineers. Past-President R. E. Dougherty spoke on "Unification, the EJC Plan."
Indiana	Dec. 8	55	Annual business meeting with installation of President Don M. Corbett and Secretary-Treasurer Edward C. Thoma. Henry B. Steeg, consulting engineer, Indianapolis, Ind., presented an illustrated lecture on prestressed concrete.
Intermountain	Nov. 17	29	Lt. Col. L. M. Rehrbough, who is stationed at Hill Field Air Base, described the role of the base in national defense.
Kansas	Dec. 15	25	Dinner meeting. J. W. Norfolk, of Topeka, Kans., was principal speaker.
Kansas City	Jan. 16	100	Malcolm S. McIlroy, professor of electrical engineering at Cornell University, talked on an electric analyzer for pipeline networks. New officers include John Q. A. Greene, president, and Richard L. Tipton, secretary-treasurer.
Los Angeles	Dec. 13	103	Finley B. Laverty was installed as president and L. LeRoy Crandall, secretary. Thomas E. Stanton,

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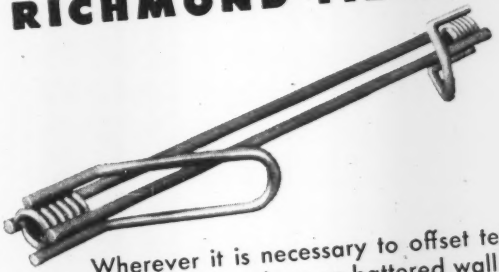

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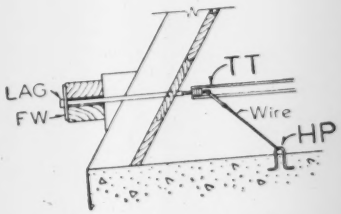

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			materials and research engineer, California Division of Highways, spoke on "The Alkali-Aggregate Reaction in Concrete."
	Dec. 13	15	Junior Forum meeting with installation of President Burton B. Most and Secretary-Treasurer William J. Carroll. Zenon Chen was guest speaker.
	Jan. 10	117	Joint meeting with University of Southern California. "The Role of the Civil Engineer in Civil Defense" was outlined by Commander James V. Ryan, of the U.S. Naval Reserve.
Maryland	Dec. 13	115	Dinner meeting with Rear Admiral J. S. Jelley, CEC USN, head of the Bureau of Yards and Docks, speaking on "You Can't Buy National Defense."
Miami	Dec. 7	23	F. D. R. Park, Section vice-president, reported on recent Third Annual Mapping Conference at University of Florida. Harry E. Neal, chief engineer of traffic and safety, Ohio State Highway Department, discussed traffic engineering. Earl J. Reeder was elected president and Warren D. Brockway, secretary.
Mid-Missouri	Dec. 15	26	Election of officers with Robert B. B. Moorman, as president, and Abner Gwinn, secretary-treasurer. Round-table discussion on EJC.
Mid-South Jackson Branch	Dec. 20	16	"China and the World Situation Today" was discussed by Dr. Glenn Morris.
Mohawk-Hudson	Dec.	....	Newly elected officers include Allan K. Booth, president, and Henry G. Harlow, secretary.
Northwestern	Dec. 4	79	Annual meeting with election of C. W. Britzius, as president, and Thomas R. Klingel, secretary-treasurer. ASCE Director Gordon Butler stressed advantages of serving on technical committees.
	Jan. 8	46	E. J. Ruble, structural engineer, Association of American Railroads, Chicago, gave a talk on structural research.
Oklahoma	Dec. 1–2	42	Annual meeting. David Benham, incoming president, spoke on Section activities. J. E. Lothers, who resigned as secretary-treasurer, will be succeeded by Robert P. Witt.
Rochester	Jan. 11	...	Joint meeting with Rochester Engineering Society, Blair Birdsall, assistant chief engineer of the Bridge Division, John A. Roebling's Sons Co., Trenton, N.J., gave an address on prestressed concrete.
Sacramento	Dec. 19	307	Juniors presented annual show.
San Diego	Dec. 19	23	Dinner meeting. A film, "American Industry at Work," was shown by J. M. Thompson, who is with San Diego Gas & Electric Co. During business session G. E. Arnold was elected president and R. K. Fogg, secretary.
San Francisco	Dec. 19	...	Dinner meeting with discussion on Local Section activities.
Seattle	Dec. 20	50	Fred F. Aldridge, director, Division of Sanitation, Seattle and King County (Washington) Health Department, gave a talk on life in Iran. Newly elected officers include President Samuel DeMoss and Secretary Wilson F. Bow.
Tacoma	Dec. 12	34	Business meeting with election of N. E. Olson, president, and C. C. McDonald, secretary-treasurer.
Toledo	Nov.	...	Col. Jack Singleton, chief engineer, AISC, described heavy steel construction work.
	Dec.	...	"The Express Highway System" and "The North End Bridge" were discussed by Arnold V. Finch, city manager of Toledo.
Texas Dallas Branch	...	...	Frank A. McCaughan was elected president and Frank C. Schroeder, secretary-treasurer.
San Antonio Branch	...	...	Recently installed to office were President Homer M. Matthews and Secretary-Treasurer Raymond C. Rippstein.
West Virginia	Dec. 1	34	Afternoon inspection trips to Huntington Airport, Marshall College Science Hall, and Memorial Field House. Business session. At evening banquet Dave Warner, consulting engineer to director of water conservation of State of Ohio, delivered an address on the history of water conservation.

STUDENT CHAPTER Notes

DREXEL INSTITUTE OF TECHNOLOGY

ASCE Director Francis S. Friel delivered an address on "The Schuylkill River Clean-up" at a recent meeting of the Drexel Institute of Technology Student Chapter. Mr. Friel is an alumnus and trustee of the Institute.

LOUISVILLE AND KENTUCKY UNIVERSITIES

Wolf Creek Dam project, a part of the Cumberland River Development program, was recently visited by members of the Student Chapters at Louisville and Kentucky universities. The tour was conducted by the Corps of Engineers, with J. I. Bowman, resident engineer, giving a talk on the over-all structure. At a dinner meeting following the trip Lewis Campbell, materials engineer, discussed the material requirements of the project, and a film on the progress of construction was shown by N. C. Manitsas.

TEXAS A. & M. COLLEGE

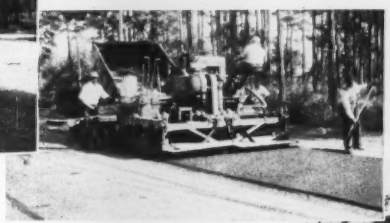
Various aspects of dam and harbor work in Texas were discussed by William P. Jones, Jr., executive officer of the Fort Worth, Tex., District of the Corps of Engineers, during a recent meeting of the J. T. L. McNew Student Chapter at Texas A. & M. College. Colonel Jones supplemented his speech with colored slides. At another meeting John Merryweather, estimator for the Farnsworth Chambers Construction Co., talked on estimating.

WORCESTER POLYTECHNIC INSTITUTE

A street inspection survey for the City of Worcester, Mass., was recently made by civil engineering students at Worcester Polytechnic Institute, under the direction of Prof. Frederick J. Sanger. At a meeting of the WPI Student Chapter, Donald Kolodne, Chapter president, discussed the history and purpose of the survey, which required eight weeks to complete and involved inspection of 59 streets and ten miles of road. The methods employed in selecting samples, extracting base material, and preparing samples for the laboratory were discussed by Edmund Johnson. Other speakers were Paul Radasch and Walter Kolodne. The Chapter now boasts 100 percent membership.

North Carolina tops worn highway with 25 miles of Texaco

Route 301, North Carolina, before construction of new Texaco Asphalt surface.



Laying the first of two courses of plant-mixed Texaco Asphaltic Concrete.

Contractor: Adams and Tate Construction Company of Roanoke, Va.

Old pavement with tack coat of Cutback Asphalt (right); first course of Asphaltic Concrete (left).

Route 301 is one of North Carolina's principal north-south highways, a popular route with many Florida-bound motorists. Last summer, a 25-mile section of this highway north of Fayetteville had deteriorated to the point that some type of improvement became imperative.

The method used by North Carolina to modernize this busy highway is economical, causes minimum inconvenience to traffic and gives the old, worn pavement a new, durable, joint-free wearing surface. Following a light tack coat of Texaco Rapid-Curing Cutback Asphalt, a resilient, heavy-duty Texaco Asphaltic Concrete pavement was constructed in two courses with a combined thickness of 3 inches. The 85-100 penetration asphalt used in the asphaltic concrete mix, also was used as a tack coat between the two courses.

In North Carolina and throughout the rest of the country east of the Rockies, road builders have been constructing and maintaining streets and highways with Texaco Asphaltic products for over 45 years. Refined from selected crudes, this complete family of Asphalt Cements, Cutback Asphalts and Slow-Curing Asphaltic Oils includes a product exactly suited to each road and street need.

Two helpful booklets which describe all types of Asphalt construction can be secured without charge by writing our nearest office.

Note the volume and type of traffic which is served by this State highway.

Completed Texaco Asphaltic Concrete pavement provides smooth, durable, skid-resistant riding surface.

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TEXACO ASPHALT

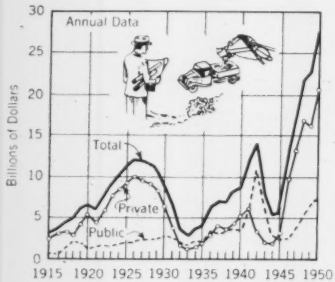
NEWS BRIEFS . . .

Construction Activity in 1950 Reaches All-Time Peak

With outlays for new construction put in place in 1950 totaling almost $27 ¾ billion, a record for the year was established both in terms of the physical volume of work put in place as well as in dollars spent, according to a joint report of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the Department of Commerce. In addition, the joint agencies report that the number of new housing units started far surpassed any previous year's total, employment in contract construction reached an all-time peak, and output of many building materials broke all previous records.

Homebuilding, which totaled nearly $11½ billion, held the spotlight during the year and accounted for most of the new records in the construction field. The housing boom, which had begun in the last half of 1949, reached unprecedented proportions in the spring of 1950 and continued to exceed all previous levels until near the end of the year. Attributing the boom to liberal financing, coupled with an accumulated backlog of housing needs, the joint agencies state that a tightening of housing credit brought the boom to an end in the fourth quarter of the year. Construction of schools, churches, hospitals, and other institutional buildings, both private and public, also achieved peak levels in 1950, and expenditures for highway construction, reclamation, and flood control rose moderately over 1949 to a new high.

Development of a different pattern of construction activity at the end of the year is noted—"partly as a result of actions taken to prevent inflation and to conserve materials that will be needed for defense purposes and partly in anticipation of further similar actions that may become necessary. While homebuilding was declining from record levels, factory, warehouse, and store building increased markedly after the outbreak of war in Korea. The immediate postwar expansion of industrial plants had been largely completed by 1949, and construction of new factories was proceeding at a relatively moderate pace until mid-1950 when many industrial establishments decided upon further expansion."



DEPARTMENT OF COMMERCE CURVES show value of new construction put in place each year since 1915.

Total private outlays for new construction in 1950, up 27 percent from 1949, amounted to more than $20 ½ billion. Expenditures by public agencies of just over $7 billion represented an increase of 11 percent over the amount spent in 1949.

Indications are, according to the joint report, that the physical volume of construction work done in the year just ended was about 10 percent above the previous record set in 1927 and, at least, 15 percent above the wartime peak established in 1942. While shortages of a number of building materials delayed construction during the year, output was stepped up in response to the unprecedented demand and by the end of the year practically all non-metallic materials were in adequate supply. Shortages of steel, copper, and aluminum may be expected to continue, as the defense program takes increasing amounts.

Appointments Made to NSRB Manpower Advisory Committee

Eleven men prominent in the fields of education, engineering, industry, and science have accepted appointment to the newly formed Scientific Manpower Advisory Committee of the National Security Resources Board, according to an announcement from Stuart Symington, chairman of the Board.

Charles A. Thomas, executive vice-president of the Monsanto Chemical Co., is chairman of the committee. The appointees are: Chester I. Barnard, president of the Rockefeller Foundation and General Education Board, New York City; J. Douglas Brown, dean of the faculty, Princeton University; Vannevar Bush, president of Carnegie Institution, Washington; Ralph Connor, vice-president of Rohm & Haas Co., Philadelphia; Lee DuBridge, president of California Institute of Technology, Pasadena; Everette Lee De Golyer, oil geologist, engineer and consultant, Dallas; Maj. Gen. Jacob Devers, U. S. Army (ret.), Washington; Gordon Gray, president of the University of North Carolina, Chapel Hill; Ben Moreell, Hon.M. ASCE, board chairman and president of the Jones & Laughlin Steel Corp., Pittsburgh; J. C. Warner, president of the Carnegie Institute of Technology, Pittsburgh; and Harry A. Winne, vice-president of the General Electric Co., Schenectady, N.Y.

The committee will advise the National Security Resources Board on matters related to the efficient utilization of scientific and technological personnel. It will examine the many proposals dealing with the use of such manpower that have been transmitted to the Board by federal agencies, industry, and scientific and educational organizations.

Army Completes Large Tennessee Power Plant

The Center Hill Power Plant on the Caney Fork River near Cookeville, Tenn., was dedicated on December 16 and is now in operation as part of the TVA power distribution system. A major Corps of Engineers construction project in the Cumberland River Valley, the Center Hill Plant will have a total installed capacity of 135,000 kw. At present the first of three 45,000-kw generators is in operation.

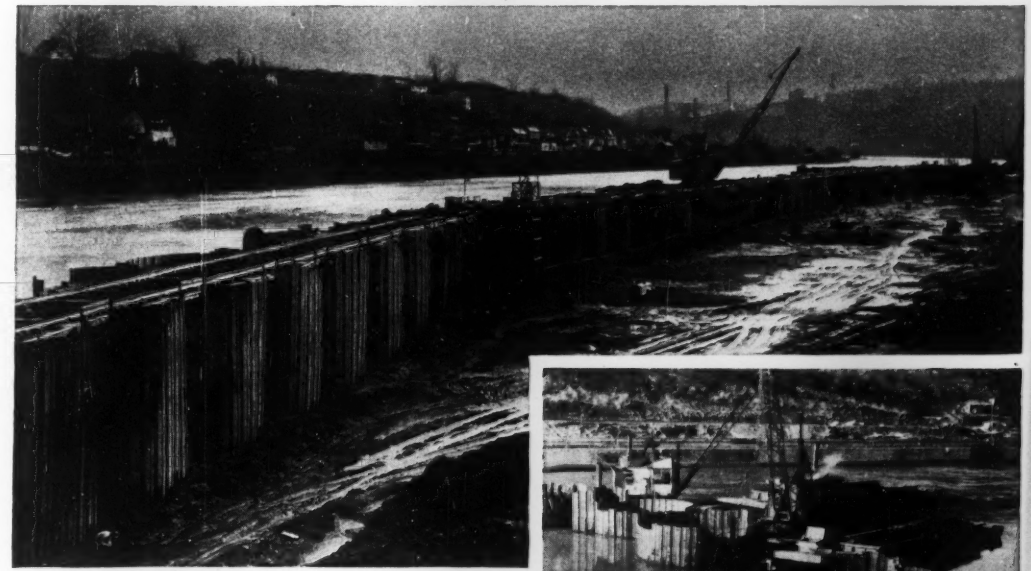
Completed in 1948 for flood control purposes, the Center Hill Dam has substantially reduced flood crests. It has a maximum height of 240 ft and impounds a reservoir of some 2,000,000 acre-ft.

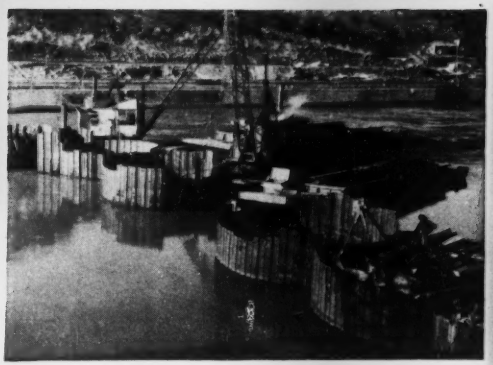
Pipe Line Expansion to Meet Wartime Emergency Needs

To meet increasing wartime emergency needs for natural gas in its mid-Western and Appalachian service area, the Texas Gas Transmission Corp. has asked the Federal Power Commission for authority to initiate a $42,300,000 pipe-line construction program. The new line, which calls for construction of 580 miles of large-diameter pipe line and necessary compressor stations, would enable the company to increase its daily deliveries by over 200,000,000 cu ft of gas and raise the capacity of its Texas-to-Ohio pipe-line system to more than 900,000,000 cu ft a day.

The project includes construction of 372 miles of 26-in. loop line along the company's present system from Bastrop, La., to Hardinsburg, Ky., including two lines under the Mississippi; building a 195-mile line linking the Gulf Coast region of southwestern Louisiana with the company's main 26-in. line in the northeastern part of the state; and addition of 13,740 compressor horsepower, including a new 4,400-hp station near Madison, Ind.

U·S·S Steel Sheet Piling helps to speed up construction on Morgantown Lock and Dam





This project will increase present channel depth of 7 ft. above Morgantown to 9 ft. The new lock and dam is designed for eventual pool depth of 12 ft. A total of 2,200 tons of Steel Sheet Piling were used in the cofferdam construction on this job.

112 connected cells form the cofferdams that expedite $6,343,650 Monongahela River channel-deepening project.

NOW being pushed to completion well ahead of schedule, the new Morgantown lock and dam offers another interesting example of what you can gain by using a combination of sound engineering, competent construction methods, and the right materials for the job.

Constructed by the Contracting Division of the Dravo Corporation for the Corps of Engineers to replace two small, outmoded locks and dams, the new 18-foot-lift tainter gate dam and the 600-foot lock are part of the improvement plan for the busy Monongahela River.

Built in three major stages, the project involved the construction of an extensive system of steel sheet piling cofferdams. The first stage was the construction of a cofferdam of 67 connected cells for the lock and guide walls; the second stage included the construction of a cofferdam of 26 connected cells enclosing the east half of the dam; stage three consists of the construction of a cofferdam of 19 connected cells enclosing the remainder of the dam. Each cell is approximately 35 feet in diameter, and the steel sheet piling, approximately 35 feet in length.

Some idea of the construction speed maintained on this vast project is indicated by the fact that the 67-cell cofferdam for the lock was begun in November 1948 and completed around the middle of the following February.

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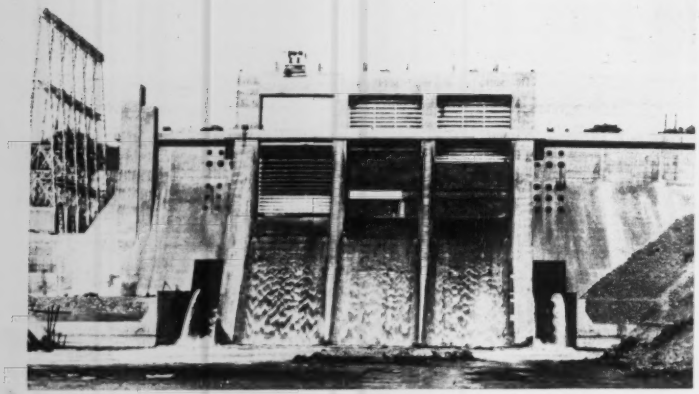
UNITED STATES STEEL

Production of Power Initiated at Davis Dam



FIRST COLORADO RIVER WATER pours through lower outlet gates and over spillway at Davis Dam, now nearing completion on lower Colorado River between Nevada and Arizona, at rate of 10,128 cfs. On January 5, first of five 45,000-kw generators went on line to furnish additional power to Southwest. All five units are scheduled to be in operation by July on integrated transmission system, with generators at Hoover and Parker dams. The fourth largest Bureau of Reclamation power installation, the Davis Powerplant will add almost a billion kilowatt-hours of energy to present annual output of Colorado River dams. Originally called Bullshead Dam, project was renamed in 1941 in honor of the late Arthur Powell Davis, Past-President of ASCE and former director of reclamation. It will be completed in 1952 at total cost of $114,000,000.

High Single-Arch Dam Is Built in French Alps

Construction of one of the highest single-arch dams in the world at Tignes in the French Alps by Electricite de France is reported in a recent issue of *The Marshall Plan News*. Built without the usual supporting buttresses, the dam will be 613 ft high. Studies of American construction equipment and of the Hungry Horse Dam in Montana, made by French engineers during a recent nine-week trip in the United States under a Marshall Plan technical assistance project, will speed work on the new dam. The Hungry Horse Dam is similar to the Tignes project.

Connection Between N.Y. and N.J. Expressways Proposed

Early construction of a connection between the express facilities of the New York State Thruway Authority and the New Jersey Turnpike Authority was planned at a recent meeting of the two agencies. Such a connection, according to Chairman Bertram D. Tallamy, M. ASCE, of the New York Thruway Authority, and Paul L. Troast, of the New Jersey Turnpike Authority, "is necessary not only to link the expressways, but to obtain maximum traffic relief to the highway systems of both states."

To speed the project, immediate joint studies of alignment and traffic were authorized. M. J. Madigan, M. ASCE, of the Long Island City consulting firm of Madigan & Hyland, was appointed to direct the studies for the New York State Thruway Authority, and W. W. Wanamaker, M. ASCE, executive director of the New Jersey Turnpike Authority, was named to direct the studies for that agency.

Consultants Appointed for D. C. Dispersal Planning

Appointment of four consultants to advise the government on problems connected with the proposed dispersal of essential government functions to points outside Washington is announced by Jess Larson, Administrator of General Services. They are Abel Wolman, M. ASCE, professor of sanitary engineering at Johns Hopkins University; Frederick P. Clark, planning director for the New York Regional Plan Association; Louis Justement, architect of Washington, D.C.; and Clarence S. Stein, architect and city planner of New York City. Mr. Larson said that others may be added later, though the group will be kept small so that it can function more effectively.

The consultants will be called together at intervals to advise the staff of the GSA and cooperating agencies on dispersal plans, particularly the relationship of the proposed offices to the development of the surrounding metropolitan area. Stating that the proper integration of the dispersed employment centers with the sound development of the expanding suburban area is of primary concern, Mr. Larson said that the GSA will work closely with the National Capital Park and Planning Commission and with the planning and governmental agencies of affected localities and the states of Maryland and Virginia.

"Dispersal is not just an emergency plan," Mr. Larson declared. "It is a plan for the permanent relocation of essential government facilities both in the interest of security and of the long-range efficiency and economy of government operation in the Nation's Capital. We want the best qualified advisers we can get."

Record Steel Output for 1950 and Expansion Program Noted

The steelmaking furnaces of the United States poured almost 97,000,000 tons of steel during 1950, or about 7,500,000 tons more than in any previous year, according to Walter S. Tower, president of the American Iron and Steel Institute, in a "year-end statement." At the peak of the year's activity, production was for several weeks at an annual rate in excess of 103,000,000 tons. "No other country," Mr. Tower states, "can ever approach the United States in steel production. In three months our furnaces have been making more steel than can be made in a year in any other country. In one month, these furnaces can exceed the annual production of every other nation except Russia, Great Britain, Germany, and France."

Present plans of the steel companies anticipate, by the end of 1952, an annual production of 22 percent more steel than was made in the peak year of World War II, according to Mr. Tower. "So many expansion moves are being planned in steel that the end of their possibilities cannot be foreseen," he declared.

Technological Development

Technological developments made by operating subsidiaries of the United States Steel Corporation and announced by the organization in a recent release will contribute to the vast expansion program. These include a fast new steelmaking process called the "turbo-hearth," sponsored by the Carnegie-Illinois Steel Corp. This process is said to permit making open-hearth quality steel in twelve minutes without using external fuel. Carnegie-Illinois engineers have also announced a roll conveyor, on which

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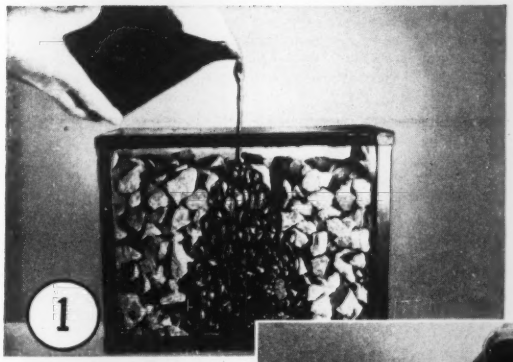

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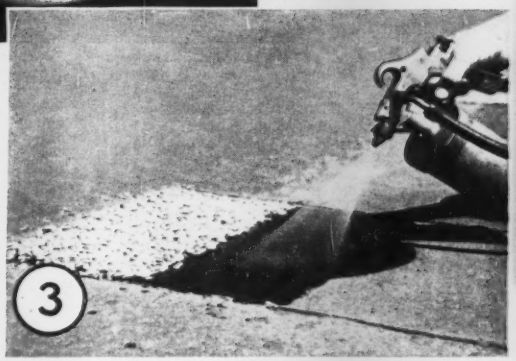

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the load seeks true center with a force as strong as gravity. By the use of newly designed rolls, its inventor said, conveyors can be constructed on narrower lines and without sideguides, which frequently damage the materials conveyed.

An exceptionally strong alloy steel, suitable for both civilian and military use, is another Carnegie-Illinois development. With good resistance to corrosion, this steel is reported to remain tough even at below-zero temperatures. To simulate oil-well conditions in testing its tubing in use in oil-producing areas, the National Tube Co. has developed a special machine which floods drill pipe with brine while rotating it for weeks under bending forces up to 1,200,000 in.-lb. The machine measures the resistance of pipe to stresses that may cause fatigue during drilling.

Plant Expansion Planned

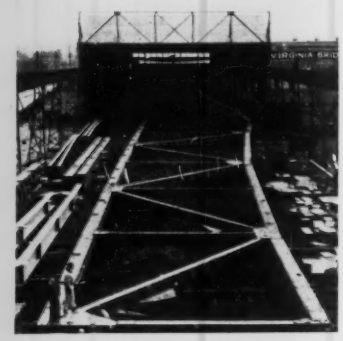
Projected plant expansion includes construction of a $400,000,000 U. S. Steel plant on the Delaware River near Morrisville, Pa., and of a huge steel mill to be built by

What's New in Bridges

CENTER SPAN OF WARD'S ISLAND BRIDGE is shown in open position 135 ft above Harlem River. Section will be lowered to connect with stationary side spans on Manhattan and Ward's Island sides in spring when structure is opened to pedestrian traffic. Photo courtesy of Triborough Bridge and Tunnel Authority.

Swing Span Fabricated for Bridge at Yorktown

THIS 500-FT SWING-SPAN SECTION, pivoted in middle, will be part of the George P. Coleman Memorial Bridge under construction at Yorktown, Va. In its open position, it will permit largest warships to pass up York River. Here in Roanoke shops of Virginia Bridge Co., workmen make certain all structural members fit with precision. Dismantled, sections will be shipped to bridge site. Article on foundations for the bridge appears elsewhere in this issue.



World's Longest Girder Lift Span Goes Into Place in Ward's Island Bridge

Recent installation of a 312-ft center span in a footbridge across the Harlem River channel at 103rd Street, New York City, completes a $2,000,000 project of the Triborough Bridge and Tunnel Authority that will provide residents of upper Manhattan with easy access to a large park development on Ward's Island. Consisting of two silicon-steel plate girders 10 ft deep, this section sets a world record for girder lift spans of the type. Other spans of equal or greater length have been of the continuous type.

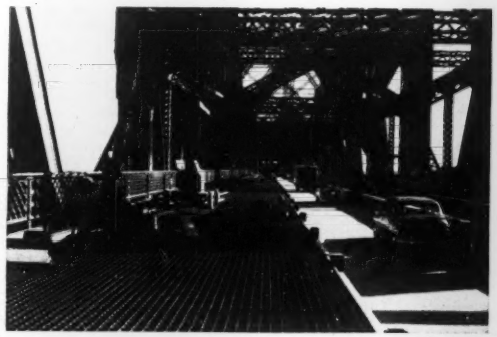
The center section, which is part of a four-span, 956-ft, plate-girder structure, was elevated into position in two operations requiring maximum precision. With the river closed to traffic, the span resting on a huge car float was released from its mooring on the left bank of the river and inched into position beneath the towers and lashed to them by means of hand-operated ropes and tackles. Cables, tied to the ends of the span and run to the tops of the towers, were then threaded into the two counterweights and carried down the other sides of the towers to two auxiliary, diesel-powered engines. As the four engines lowered the counterweights, the span was slowly hoisted into its normal closed position 55 ft above high water level. The entire operation required about five hours.

In a subsequent operation on the following day, the span was raised to open position 135 ft above water level, where it will remain until automatic raising and lowering machinery has been installed. In the spring when the bridge is opened to traffic, the span will be lowered to the level of the two stationary spans connecting with the east and west banks of the Harlem River. The clearances are similar to those at the Harlem River lift bridge on the Manhattan approach to the Triborough Bridge.

Designed for a capacity of 8,000 persons per hour, the bridge has a 12-ft walkway formed by a 2-in. steel grid filled with con-

the National Steel Corporation at Paulsboro, N.J., on the Delaware. Located about 35 miles from each other, the two plants will increase annual steel capacity by about 3,000,000 tons. These and other facilities now being planned would bring the steel-producing capacity of the United States to 115,000,000 tons annually by the end of 1952.

The U. S. Steel Corporation has long been considering construction of an East Coast mill, and its Morrisville plant will probably be the largest single steel expansion project in history. Its blast furnaces will have an annual capacity of 1,200,000 tons of pig iron, and the nine open-hearth furnaces an annual output of 1,800,000 tons of basic steel. Built on a 3,900-acre site at tidewater on the Delaware opposite Trenton, the plant will have direct siding connections to the Pennsylvania Railroad and access to all major transportation facilities in the East. In addition, the Delaware River is being dredged to facilitate water transportation of the steel output to markets abroad. Construction will start early this spring and be completed by the end of 1952.



Renovation of St. Lawrence River Bridge to Expedite Quebec Traffic

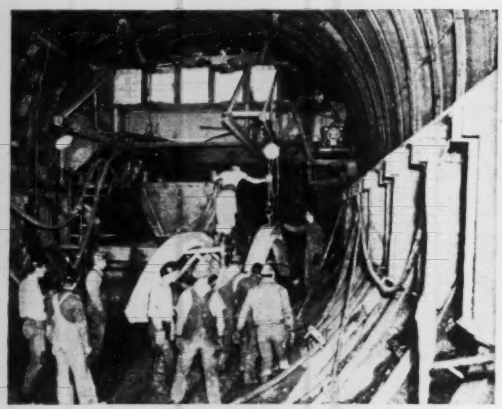
WORK UNDER WAY ON QUEBEC BRIDGE and its approaches will facilitate automobile travel to city from south bank of St. Lawrence River. Originally designed for railroad traffic only, the long cantilever structure (left) was renovated in 1929 to provide 15-ft automobile roadway, which has been increasingly inadequate to meet modern traffic demands. Photo shows construction of new half section of roadway over disused railway track, which will double present roadway width. One railroad track will remain in use. Present improvement project also includes construction of new 780-ft arch-span bridge (right-hand photo) across the Chaudiere River. Providing three-lane highway equal in width to renovated Quebec Bridge Highway, Chaudière Bridge constitutes part of efficient feeder system to main crossing. Entire improvement project is being carried out by Quebec Government, with Dufresne Engineering Co., Ltd., in charge of work. Steel work is fabricated and erected by Dominion Bridge Co., Ltd.

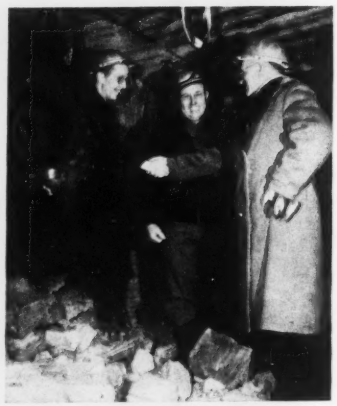
crete. The two towers, housing the machinery and counterweights, are of box construction 330 ft on centers. They are supported by concrete pedestals resting on single concrete caissons carried to rock at a depth of about 80 ft. Steel H-piles driven to bedrock support the concrete pier for the Manhattan side span, while the pier common to the two spans on the Ward's Island side is founded on a concrete caisson. The approach ramp on the Manhattan side connects with a pedestrian overpass crossing the Franklin D. Roosevelt Drive. On the Ward's Island side, a 100-ft-long reinforced concrete ramp leads from the side-span abutment to the park. Maintenance and operation of the finished structure will be under the New York City Department of Public Works.

Plans for the bridge were prepared by O. H. Ammann, M. ASCE, New York City consultant, with Ammann & Whitney of New York supervising its construction. The contract for construction of the superstructure was held by the American Bridge Co., and the contract for the substructure by Peter F. Connelly and Senior & Palmer. Robert Moses is chairman of the Triborough Bridge and Tunnel Authority, financing and sponsoring agency, and George E. Spargo, M. ASCE, general manager.

New Mississippi River Span Is Opened to Traffic

CEREMONIES ON BOTH SIDES OF MISSISSIPPI marked official opening, on January 12, of new Veterans' Memorial Bridge, a 7,800-ft cantilever span, between cities of St. Louis, Mo., and East St. Louis, Ill. Financed and built by City of East St. Louis, at cost of $11,000,000, new toll bridge is one of six vehicular crossings between the two cities and the first erected since 1916. It lies two blocks north of famous Eads Bridge, which was opened in 1874 and is oldest Mississippi River span. Construction details were outlined in an article in the March 1950 "Civil Engineering" by Craig P. Hazelet, M. ASCE, of Chicago and Louisville firm of Hazelet & Erdal, consultants on project. Traffic studies were made by Parsons, Brinckerhoff, Hall & Macdonald, of New York, and general construction contract was held by William J. Howard, Inc., of Chicago.





CONSTRUCTION CREW (in view at far left) assembles steel rib segments, using mining jumbo, excavating and erecting machine. Photo at left shows Mark Foote, project manager of S. A. Healy Co. and Material Service Corp. being congratulated by Governor Brunsdale. Standing in center is Everett Knudsen, resident engineer on tunnel and stilling basin.

Holing Through of Garrison Dam Tunnel Completes Excavation Operations

J. J. WALSH, M. ASCE, State Engineer of North Dakota, Bismarck, N. Dak.

Final mining operations were completed at Garrison Dam, the second unit in the Pick-Sloan Plan for the control of the Missouri River, on January 13, when the last of the eight tunnels was holed through the world's largest rolled-fill earth dam into the intake structure on Tunnel No. 3, connecting with the previously constructed upstream portal. [An article by Col. J. S. Seybold, outlining the project, appeared in CIVIL ENGINEERING for October 1949.]

Present at the final holing through were Gov. Norman Brunsdale, members of the State Water Conservation Commission, Col. F. M. Albrecht, district engineer, Corps of Army Engineers, in charge of the construction work, and S. A. Healy, representing the contractors.

Mining through this 1,200-ft-long tunnel completed excavation operations under the dam started in 1948 by the S. A. Healy and Sons Co. and the Material Service Corp., both of Chicago. Their contract included mining and lining of the tunnels.

Of the seven remaining 1,200-ft tunnels being constructed as part of the structure, four have been completely lined and grouted, one is lined and being grouted. The other two are being lined with concrete. Grouting operations consist of pumping neat cement mixture behind the completed concrete lining to secure a perfect contact with the surrounding formation. All will be lined with from 2½ to 3 ft of reinforced concrete, and all are scheduled for completion in the spring.

The eight tunnels are practically parallel, being spaced on centers 62 to 70 ft at the upstream portal. Center lines of the tunnels diverge slightly, increasing the space of the down portals from 75 to 85 ft, in order to allow for economic design of the stilling basin. Five of the tunnels, with finished inside diameter of 29 ft, are designed as power tunnels, and will have 24-ft steel penstocks assembled inside their bores. Each penstock will supply an 88,000-hp turbine. The initial three turbines are now being designed and built by the Baldwin Locomotive Works of Eddystone, Pa. The other three tunnels will be utilized for reservoir regulation.

Mining of the tunnels was accomplished by the full-faced method. The head was drilled for an 8-ft draw with a hand-held air-drill driving a coal auger. The drill holes were loaded with dynamite of 20 percent strength and the head fired on nine delays. The mining jumbo used for mucking and placing the circular steel ribs was carried upon rails mounted upon brackets attached to the rib steel already placed, and then moved forward over the muck pile.

The structural steel ribs were divided into four segments. The jumbo carried the top segment, which was set to grade by means of hydraulic jacks, the crown being supported by other hydraulic jacks, while the periphery was drilled for rib placing. Concurrently mucking operations were carried on under the jumbo, and as the muck pile was reduced, breast jacks and side jacks were set for the protection of miners trimming and setting steel on the sides and in the lower parts of the tunnel. Mucking work was done with a 100-hp Conway mucker loading 4-cu yd narrow-gage cars pulled to the outside of the tunnel portal by a battery locomotive. The cars were dumped by means of a crane, and the muck reloaded on large earth movers and hauled to an area a mile and a half from the lower portal.

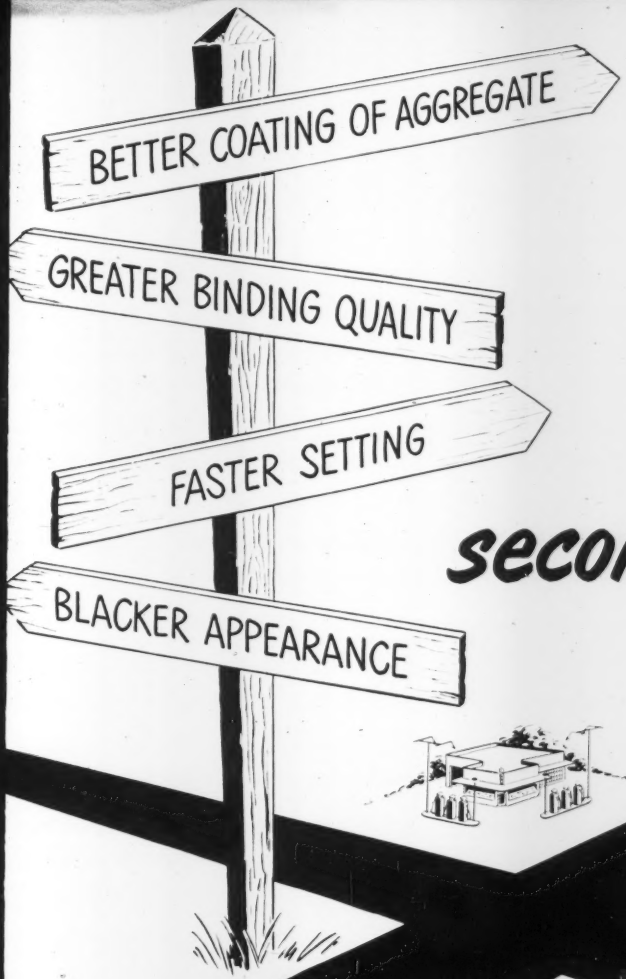
The concrete mixing plant, located about 200 ft downstream from the portal of Tunnel No. 1, consists of a Johnson batcher with two 2-cu yd Koehring tilting mixers discharging into a wet hopper. Aggregate is brought to the plant by conveyor belt from a reclaiming tunnel, and cement is conveyed through a Robertson air system. Refrigeration is accomplished by a cold air plant incorporating five 50-hp Freon compressors.

Building of the intake structure and control works for regulating the flow of water through the tunnels is proceeding on schedule, and contracts have been awarded and construction work is progressing on the power plant below the tunnels. When completed in 1954, Garrison Dam will be over 12,000 ft long and 210 ft high and will contain 70,000,000 cu yd of rolled earth-fill, 1,500,000 cu yd of concrete, and 650,000 cu yd of riprap. Total excavation will amount to 86,000,000 cu yd. Ultimately, there will be five power units, with a capacity of 400,000 kw. At maximum pool elevation the reservoir above the dam will contain 23,000,000 acre-ft, and the length of the reservoir will be 200 miles, the second largest in the world.

The project is being constructed by the Army Corps of Engineers, under the supervision of Gen. S. D. Sturgis, Jr., division engineer at Omaha, and Col. F. M. Albrecht, district engineer, Fort Lincoln, Bismarck, N.Dak.

Turkey Plans Hydraulic Development Program

An engineering survey of proposed hydraulic development in Turkey will be made by the New York City consulting firm of Frederic R. Harris, Inc., under the terms of a contract with the Turkish Ministry of Public Works. Walter D. Binger, M. ASCE, an associate of the firm, is already in Turkey launching the initial stages of the survey, which will include a practical program of specific hydraulic projects and economic and technical recommendations for implementing it. D. P. Roberts, Assoc. M. ASCE, will be resident senior engineer in Turkey for the entire period of the survey.



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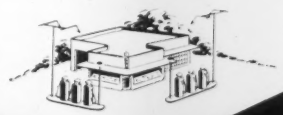

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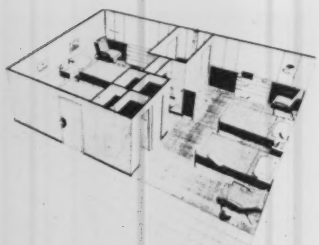
Hotel-Type Barracks Planned by Air Force



HERE IN PERSPECTIVE is typical unit for housing four airmen in revolutionary new 216-man hotel-type barracks, to be built at Offutt Air Force Base near Omaha, Nebr., early in 1951. Four closets are shown in foreground, one for each man. Each room will have lavatory, and each two rooms will have shower and toilet between them. Use of prefabricated sandwich-type panels of sheet steel packed with fiber for outside walls and 1³/₄-in. fireproof sandwich panels for interior walls will make cost of quarters less than $1,500 per man as compared with $2,000 or more per man for old-type open-bay structure.

Contracts for AEC Plant at Paducah, Ky., Awarded

Selection of four contractors for architect-engineer and construction work on the Atomic Energy Commission's new Uranium-235 Plant, to be built on the site of the Kentucky Ordnance Plant at Paducah, Ky., is announced by Kenneth A. Dunbar, manager of the Kentucky area office of the AEC.

F. H. McGraw & Co., of Hartford, Conn., receives the principal construction contract for work estimated to cost about $350,000,000. The contract, said to be one of the largest single contracts ever awarded, will include the construction of all structures at the site and installation of production equipment. Donald W. Neville, vice-president of the company, will head up the project, which will require nearly 10,000 men and take more than two years to complete. Clifford S. Strike, M. ASCE, is president of the company.

The three architect-engineer firms selected for work at the new site are Giffels & Vallet, Inc., of Detroit, for preliminary engineering and design of the process plant and inspection of its construction; Sargent & Lundy, of Chicago, for power studies and design and inspection of construction of power facilities on the site including a substation and electrical distribution system; and Smith, Hinchman & Grylls, Inc., of Detroit, for specialized design and engineering for sanitary and fire water systems, a sewer system and sewage treatment plant, steam plant, and administrative and auxiliary buildings.

The Carbide & Carbon Chemicals Division of the Union Carbide & Carbon Corp. which operates the U-235 production plant for the Commission at Oak Ridge, Tenn., will operate the new plant.

Aluminum Programs Will Boost Defense Production

Two major programs of the Aluminum Company of America will increase the annual production of aluminum for defense by more than 25 percent, according to I. W. Wilson, senior vice-president of the organization. The first, called a "quick action" plan, involves the use of stand-by facilities owned by the company, which require the use of higher cost electric power than is economical for peacetime smelting of aluminum. The second phase is a long-range expansion plan for enlarging the smelting facilities of the company's Point Comfort, Tex., plant and building a new plant that will utilize electric power generated from gas or coal fuels.

Designated an emergency measure, the first plan requires use of smelting equipment located at ALCOA plants at Massena, N. Y., and Badin, N. C. Public utility companies in these areas will furnish high-cost power to permit immediate use of facilities that ordinarily are not operated because of the absence of adequate supplies of low-cost electric power, according to Mr. Wilson. It is estimated that use of these facilities will add to the nation's defense stockpile at the rate of approximately 158,000,000 lb a year.

The construction of permanent new capacity at the Point Comfort reduction plant will increase production by about 240,000,000 lb a year, Mr. Wilson stated. The present capacity of the plant, which was erected after the war and has been in operation since early in 1950, is 114,000,000 lb annually.

European Engineers Study Environmental Sanitation

Leading sanitary engineers from 16 European countries were brought together for the first time at a recent Seminar on Environmental Sanitation held at The Hague. The primary objectives of the conference were to disseminate knowledge of the status and needs of sanitary engineering in the participating countries; to stimulate and coordinate European research in environmental sanitation; and to bring about closer relationships among European sanitary engineers. Another major subject on the agenda was the training of sanitary engineers, with special attention to problems created by the increased demand for trained specialists in public-works and disease-control programs.

Sponsoring groups were the Netherlands Government, the World Health Organization, and the International Health Division of the Rockefeller Foundation. The steering committee that planned and conducted the seminar was aided by Herman G. Baity, M. ASCE, professor of sanitary engineering at the University of North Carolina, on temporary duty as a consultant with the WHO. Prof. W.F.J.M. Krul, director of the Government Institute for Water Supply, presided over the sessions, and F. C. van Heek, of the Research Committee for Sanitary Engineering, was conference secretary.

The World Health Organization is planning to publish the proceedings of the conference, though details as to channels of distribution and costs are not yet arranged. Inquiries regarding the matter should be addressed to Herbert Bosch, Chief, Environmental Section, World Health Organization, Palais des Nations, Geneva, Switzerland.

Drop in Production of Building Materials Foreseen

Production of building materials and equipment, which has exceeded all past records during 1950, will fall well below the new peak in the coming year, according to A. Naughton Lane, president of the Producers' Council, national organization of building products manufacturers.

"The extent of the decline in 1951 is unpredictable, because no one can tell at this time how far defense needs will curtail civilian construction," Mr. Lane stated. "However, in some lines the cutback in production of materials will be less than the reduction in building volume, because inventories in the hands of producers and dealers have been relatively low in recent months and will be built back to normal in the first part of the new year.

"It now appears certain that the limited supply of materials containing steel, copper, and aluminum will be the prime factor limiting construction volume in 1951, even in the case of housing where credit controls have been put into effect."

The record production of materials in 1950 is attributed to "expansion of plant capacity, introduction of new products, and increased efficiency in existing plants."

Instrument Manufacturer Celebrates Centennial

In 1851 Otto Fennel pioneered in a business in Kassel (now in the U.S. Zone), Germany, of designing and making theodolites, transits and levels for civil engineers. At 92, his son is conducting the business under the name of Otto Fennel Soehne. Fennel surveying and geodetic instruments are distributed in the United States through Norbert Dienstfrey, New York City.

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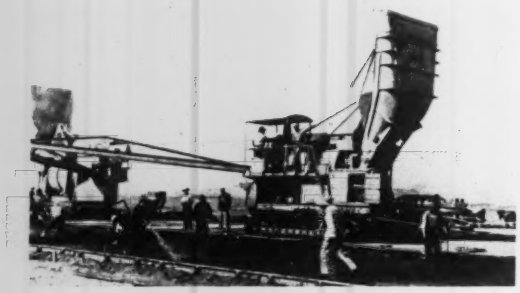
American Construction Equipment Speeds Work on Beirut Airport



PIONEER USE IN NEAR EAST of "assembly line" construction methods and high-speed precision equipment on construction of new airport in Beirut, Lebanon, permits early completion of project despite handicap of untrained native labor. Said to be the largest and best equipped air terminal in the East, the project involved placing of 750,000 sq yd of 10- and 12-in. concrete paving. In trying to select relatively trouble-proof equipment and mechanize operations as completely as possible, American engineers on project obtained Blaw-Knox packaged concrete construction equipment. Chief items in package were two MultiFoote DuoMix 34 E pavers, one model SD 25-ft spreader with vibrator, one Model XE finishing machine, adjustable to 25-ft width, one three-compartment aggregate bin with scales, and several thousand feet of 12-in. steel paving forms. Here the two pavers are shown working in tandem. Concrete placing began in October 1949 and was completed in early summer of 1950.

United States Faces Shortages in Mineral Raw Materials

JAMES BOYD, Director, Bureau of Mines and Administrator, Defense Minerals Administration, Washington, D.C.

In the face of a possible total war, in which our industrial potential may well be the deciding element, it is timely to discuss raw materials, the substance upon which industry feeds. In discussing minerals, we must include mineral fuels, construction materials, and fertilizer materials as well as metals, and such nonmetallics as quartz, mica and sulfur. Today their production provides a vital 8 percent of the gross national product and is essential to industry, to agriculture, and to all other facets of our daily living. It is metals and construction materials that provide the means whereby the sun's energy, transformed into fossilized coal, petroleum, or coal and shale, is converted into useful work. These fuels permit us to live more comfortably, and their availability is essential to give us mobility as well as provide us with the sinews of war.

Our ingenuity in making use of available mineral resources has permitted the United States with only 7 percent of the world's population, to do 40 percent of the world's work. In doing it, however, we consume 50 percent of the world's mineral production and 70 percent of her oil production.

The United States leads in per capita consumption of minerals. We consume eleven times more petroleum than all of the rest of the World put together, four times the steel and copper, three times the lead and zinc, and we require other important mineral products in similarly tremendous proportions. In a world where the population is increasing rapidly and wars are becoming more and more destructive, standards of living are also advancing—particularly in the United States. Consequently, our mineral production must expand at an ever-increasing rate. What complicates our problem is the fact that production from domestic resources, despite rapid growth, cannot keep pace with our accelerated demands for minerals. In other words, our self-sufficiency is declining. The appetite of the nation for manufactured goods exceeds the capacity of its raw material facilities. Take for illustration a dramatic example. The United States exported copper, lead, and zinc until some time between the two World Wars. Since then we have been more and more dependent on imports. This pattern is equally true to a greater or lesser degree for nearly every mineral raw material, with the exception of sand and gravel, limestone, coal, clays, potash and phosphorous.

Manganese, a material absolutely essential to efficient steel production, was produced from small deposits in our eastern states when the steel industry was in its infancy. As the industry grew, we became almost entirely dependent upon imports, to a considerable extent from Russia. Soon after World War II Russia deliberately cut off our manganese supply. Inasmuch as there were no important deposits in this country that could be brought to production without extensive research and heavy subsidies, imports were stimulated from India, South America, South Africa, the Gold Coast, and Brazil. Now because these sources of supply are distant and perhaps uncertain, and because they do not produce enough to meet our industrial needs plus those of the stockpiling program, we are beginning to develop our own submarginal deposits.

Our situation with respect to manganese is not unique. As our industry has expanded we have not found enough of other minerals at home to meet more than a microscopic portion of our total needs. Our nickel comes from Canada; asbestos from Africa; chromite from Turkey, Southern Rhodesia, New Caledonia, and the Philippine Islands; tin from Southeast Asia and South America; and diamonds from Africa and Brazil.

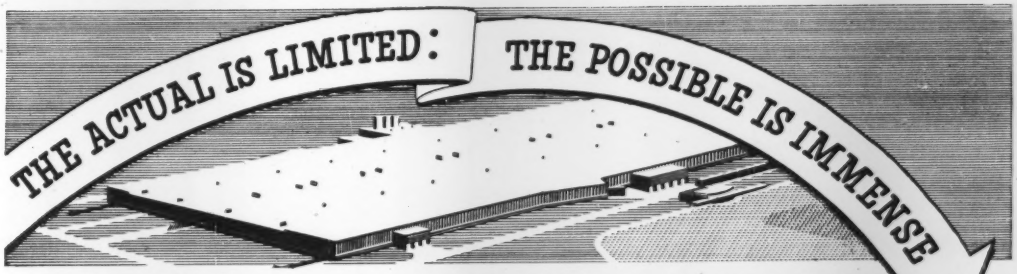
The pessimist might say that we are rapidly becoming a "have not" nation or that some day our industrial economy will slow down through lack of sufficient raw materials to keep it alive. It does not signify a lack of faith in America to call attention to the seriousness of our resource position. While we may by no means be in desperate straits as yet, there are danger signals on the horizon. Nations, despite the United Nations, are becoming more nationalistic in respect to their resources. This is due not only to nationalistic tendencies but also to political instability in many nations abroad.

Fortunately many of us have faith in the American democratic system and the inherent ingenuity and resourcefulness of our people. As long as industry and individuals possess freedom of opportunity to exercise their own ingenuity, there is no need to fear industrial decline or for the status of our national security through lack of raw materials.

Stockpiling and Conservation

In the case of raw materials for which there are no satisfactory substitutes, and which cannot be produced in necessary quantities, it is essential that we prepare for an emergency by making use of the stockpiling provisions of Public Law 520 of the 79th Congress. We have long been wasteful in our use of raw materials, for only under the influence of price have we resorted to substitutes. As a rule we have insisted on what we believed to be the best and have used it in a profligate manner. Our engineers in every field of design and production have paid only secondary attention to the utilization of valuable raw materials in ways that will yield their longest and maximum values. Conservation of metals and minerals, in the sense of optimum suitability and maximum use, offers a great challenge to the engineering profession.

As an example, our petroleum production methods today leave over 50 percent of the originally discovered oil in the ground, 30 percent of the gas, 30 percent of the coal (in Europe laws require 100 percent extraction of coal), 25 percent of the potash, 20 percent of the bauxite, and 12 percent of the copper. Since minerals are deposited in terms of geologic eras, they are essentially irreplaceable. Once mined they are gone for



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Industrial Construction. On the publishing plant for the Baltimore Sun, the bid on riveted construction was $551,508 . . . welded construction only $482,986, saving $68,522. Structural weight was cut 7%.

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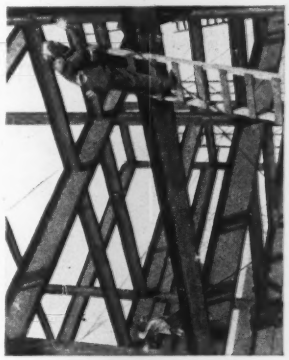
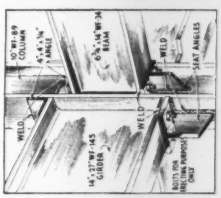
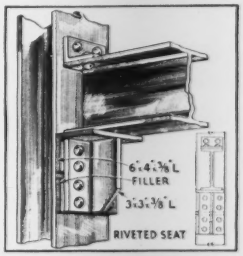




Beam-to-Column Connection *used on three story Fenn College Mechanical Engineering Building. Photo shows welders completing column splices.*

Typical Open Box Column, *one of 14 shop fabricated for Associated Telephone Co. exchange, West Los Angeles, California.*

the ACTUAL



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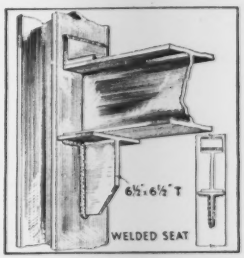

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good, so it is essential that we use efficiently and effectively every pound that we take from the earth. There are vast areas in the United States which have not been scientifically prospected. To find new ore deposits, large sums of highly speculative venture capital, intuitive imagination, and financial courage will be required. This job must be done by individuals who are free to use initiative and imagination.

Finally there is the question of replacement or substitution by materials in more abundant supply for those which are growing scarce. The most dramatic illustration is that of fuels. Coal comprises 95.5 percent of our fuel reserves on the basis of heat content, oil shale 3.6 percent, petroleum and natural gas as now known only four tenths of a percent each. Yet today coal provides less than half of our energy. Obviously in time this trend must be reversed. Though we are finding more oil and gas each year, it is inevitable that the day will come when we must return to solid fuels for most of our energy. Hence for defense purposes the government, through the Bureau of Mines, is doing extensive research in synthetic fuels.

Experiments with Titanium

In a very different way, new metals will find uses to meet the growing demands of industry as and when they are needed. For some years the Bureau of Mines has been experimenting with the interesting new metal, titanium. The Bureau has distributed enough of this metal to research laboratories to prove its worth; now industry is beginning to produce it. Since it is much lighter than steel, more resistant to corrosion and stronger than aluminum, it has wide structural and engineering uses. There are abundant sources of titanium ores near at hand, and expanded use of this metal could take considerable pressure off reserves of other metals that are in short supply. Titanium is today at about the point of development that aluminum was 50 years ago, and may enjoy a future of similar popularity.

Possible uses of magnesium have not been fully explored. Here is a strong light metal which is available in unlimited quantities from sea water and extensive rock formations throughout the United States. Undoubtedly magnesium will become a most important industrial metal in the future. Zirconium is another metal, virtually unknown in its metallic state a short while ago, for which increasing uses may be found.

This problem of an adequate and reliable supply of mineral raw materials has been foreseeably recognized in the Defense Production Act and a large portion of the fiscal obligation under the Act is provided for this purpose. The Congress has instructed the President, and he in turn the Secretary of Interior, to encourage the exploration for, and development of, new sources of supply. Furthermore, he is being given the financial tools to work with.

Under the Defense Production Act, the government has alternative methods of stimulating expansion of minerals production. First, the government may purchase mineral products at negotiated prices if it is determined that the material is required and is essential to the national defense. Secondly, loans may be made, "for the expansion of capacity, the development of technological processes or the production of essential materials, including the exploration, development, and mining of strategic and critical metals and minerals." Such loans are only available if other means of financing cannot be found from private or other than federal sources. Finally, the government may guarantee private loans raised for these purposes. Applicants for government assistance may also seek early tax amortization through the provisions of the Internal Revenue Act of September 23, 1950.

Recent legislation makes it clear that we must place major reliance on private industry rather than government to do the job. At the present time neither can work effectively without the other. If we are to have the mineral life blood for our war and peacetime industrial effort, government and industry must work in the closest harmony in solving our supply and production problems.

[These remarks are excerpted from a paper presented by Dr. Boyd at a meeting of the Los Angeles Engineering Council.]

Positions Announced

Corps of Engineers, Alaska. The Corps of Engineers, U. S. Army, announces many engineering openings in Alaska. Positions carry salaries ranging from GS-3 through GS-12, with a 25 percent cost-of-living bonus. For complete information write to the Portland District, Corps of Engineers, Department of Army, Portland, Oreg.

U.S. Civil Service Commission. Applications for engineering positions in the research and development field are being accepted by the U.S. Civil Service Commission, with starting salaries from $4,600–$8,800 a year. Details and application forms may be obtained from the U. S. Civil Service Commission, Washington 25, D.C.

State Roads Commission, Maryland. Announcement of an examination for Junior Assistant Highway Engineer I, with a yearly salary of $3,850–$4,815, and Junior Bridge Draftsman, with a yearly salary of $3,174–$3,649, for the Maryland State Roads Commission, has been made. Inquiries regarding these positions and requests for application forms should be addressed to the State Employment Commissioner, 31 Light Street, Baltimore 2, Md.

R. Robinson Rowe, M. ASCE

Prof. Noah G. Neare
Esseyeville, U.S.A.

Dear Sir and Prof.:

Reluctant as I am to sabotage your problem hypothecated on the obliteration of Xmas-card addresses by a flood reaching the Swutchburg postoffice, I must in justice to my competent staff acquaint you with some of the facts of life and love.

Unlike that in Reno, our flood was a deluge of mail, all of which was correctly distributed. Also, your reference to "many Dutch families and more Swedes" must have been based on the 1850 census. The 1950 census, confirming Nature's second and Newton's first law, shows that all families are now Swutch.

/s/ M. Erik Kris Maas
Postmaster

"I should have known," moaned the Professor, as he tucked the letter away.

"Even so," said Joe Kerr, "this Swutchman, can't keep me from proving I solved the problem he ruined. Algebraically, it is equivalent to finding the number of Swedish families, s, in:

$$s(s-1) + d(d-1) = 508(s+d)$$
$$s^2 + d^2 = 509(s+d) \quad \ldots\ldots(1)$$

This is one of those diofanatics that you usually trip me with, Professor, but I didn't waste much time finding that $s = d = 509$."

"'Diophantics,' he means," sneered Cal Klater, "and how can $s = d$ if there are 'more Swedes'? Actually Joe's Eq. 1 is fairly simple, for we can substitute

$$s = p(p+q) \text{ and } d = q(p+q) \quad (2)$$

to get $(p^2+q^2)(p+q)^2 = 509(p+q)^2$

so that $$p^2 + q^2 = 509 \quad \ldots\ldots(3)$$

Then, by trial, I found that $p = 22$, $q = 5$ was the only solution, so that, from (2), $s = 594$ and $d = 135$."

"It wouldn't have been so simple," added Ken Bridgewater, "if he'd asked for the number of Dutch families, for the substitution (2) could be amended to $d = p(p-q)$ with the same result, except that $d = 374$. Incidentally, I still like Joe's answer, for the Swedes could equal the Dutch in families and still outnumber them, simply by having more Swedelets than the Dutch had Dutchlets."

"Conceded," said the Professor, "but it diverts us from the more interesting solution. More generally and academically, for any number, as well as 509, that can be represented by the sum of two squares in (3), there will be four solutions:

Twelve Answers to a Difficult Storage Problem

When Long Beach, California, wanted to enlarge its water storage capacity, a difficult problem had to be solved before any new installations could be built. Local geological conditions made it necessary to consider the possibility of ground settlement and earthquake tremors.

Realizing the situation, research engineers went to work and, after lengthy experimentation came up with the answer . . . or actually a dozen answers. They recommended building twelve identical Horton all-welded steel reservoirs with a 40,000,000-gal. total capacity on nearby Dominguez Hill. This site was selected because it was the only elevated area available to serve the rapidly expanding residential and industrial districts on the west side of the city. The choice was also ideal because the bottoms of the new reservoirs are at an elevation of 170 ft.—the same as Long Beach's other reservoirs on Alamitos Hill, built in 1932.

By designing a reservoir system comprised of twelve individual tanks instead of one large tank, earthquake damage isn't likely to be as severe, and if ground settlement should occur, each unit will settle separately.

These tanks are 132 ft. in diameter by 35 ft. high. Each of them holds about 3½ million gallons of water. They are built of welded steel plates in five courses, ranging from ⅞ in. thick at the bottom to ¼ in. thick at the top. Twenty ⅞-in. diameter tie rods extending radially from a central column, reinforce the upper part of the shell of each reservoir.

Horton welded steel reservoirs, standpipes and elevated tanks daily provide hundreds of municipalities with finer storage facilities. It's the result of Horton engineering and construction methods.

Reservoirs and standpipes are built in capacities up to 10,000,000 gallons, and elevated tanks in standard sizes from 5,000 to 3,000,000 gallons.

Write our nearest office for estimates the next time you need new storage facilities. We will be glad to give you complete information without obligation.

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Detroit 26 . . . . . 1541 Lafayette Bldg.
Havana . . . . . 402 Abreu Bldg.
Houston 2 . . . 2128 National Standard Bldg.
Los Angeles 17 . 1556 General Petroleum Bldg.
New York 6 . . . . 3395—165 Broadway Bldg.
Philadelphia 3 . 1652—1700 Walnut St. Bldg.
Salt Lake City 4 . . . 509 West 17th South St.
San Francisco 4 . . . . . 1584—200 Bush St.
Seattle 1 . . . . . 1309 Henry Bldg.
Tulsa 3 . . . . . 1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

$s = p(p + q)$ or $q(q - p)$
$d = q(q + p)$ or $p(p - q)$

with s negative in two and greater than d in the other two. Now, for a new assignment, listen to Guest Professor Sauer Doe."

"I think, Professor, they would like a problem I ran into in Oz, where they use unusual units and saw their timbers into treams, so called because of their triangular sections. Once I had to support a concentrated load of 10 ig plus 10 percent impact at the center of a simple span of 100 uk. Could I use a tream 9 uk on a side if the allowable flexural stress was 10 ig per sq uk?"

[*Cal Klaters and Kens were Stoop* (*John L.*) *Nagle, A. Nuther Nutt, Ed C. Holt, Jr., Flo Ridan* (*Charles G. Edson*), *Richard Jenney, Elihu Geer, G. Nyuss* (*Robt. M. Dodds*), *T. J. Hogg, Eepee* (*E. P.*) *Goodrich, James R. Bole, and Thatchrite* (*Guy C. Thatcher*). *Guest Professor Sauer Doe is Marvin A. Larson. Also acknowledged are solutions of the October and November problems from George B. Richardson, and of the latter from Uppan Atom* (*Count Harvey*).]

NEW IN EDUCATION

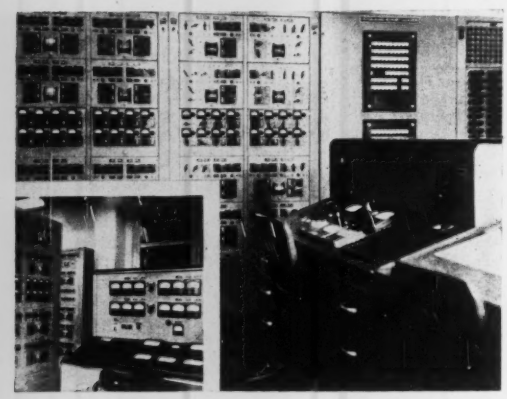
Idaho State College has completed field work undertaken under contract with the Idaho Operations Office, U.S. Atomic Energy Commission, as part of a survey to determine the natural radiation level in the vicinity of the AEC's reactor testing station on the Snake River Plains. Under the AEC program, representative samples of plant and animal life, soils, water and air of the Plains area have been analyzed for radioactivity.

Additional studies on construction methods used in building homes will be made by the Small Homes Council of the University of Illinois under a new research grant given to the University by the Lumber Dealers Research Council. The study will be made on two houses of identical design—one of precast light-weight concrete wall panels 8 ft high in units of various widths and the other of frame construction. Both will be one-floor, basementless structures built on an insulated concrete floor slab.

Better and more economical roads for Iowa is the aim of three research projects instituted at the Engineering Experiment Station at Iowa State College, with a grant of $57,700 from the Iowa State Highway Commission. A major problem in road building, especially in secondary roads, is being tackled by one team of researchers which is looking for better ways of stabilizing soils. A second research project assigned to the college is the investigation of the feasibility of the design, construction, and operation of a track for testing highway pavements and bases. A third project, which has been going on for some time, involves a study of procedures for carrying on certain traffic surveys. Present means for making "origin and destination" surveys give good results, but are said to be too expensive.

An extension course in advanced highway engineering is being offered at the University of Delaware under the direction of Prof. Charles N. Gaylord, Assoc. M. ASCE, head of the civil engineering department. Delaware State Highway Department engineers and others interested in the field, are eligible for the course.

Network Calculator Aids Study of Hydraulic Flow



SOLUTION OF hydraulic-flow distribution problems through use of a-c network calculator, shown here in Texas A. & M. College laboratory, College Station, is reported by Prof. L. M. Haupt, supervisor. An adjustable electric system for setting up small-scale study of actual electrical network, calculator is useful in analysis of any mechanical, hydraulic, thermal or other system for which electrical analogy may be determined.

DECEASED

Edwin Wallace Barbee (Assoc. M. '40) water purification engineer for the San Francisco Water Department, at Millbrae, Calif., died recently at the age of 43. He was a graduate of the University of California. Prior to service in the U.S. Army from 1941 to 1945 Mr. Barbee was connected with the Wallace & Tiernan Sales Corp. He was a member of the American Water Works Association.

Harry Andrew Betaque (M. '26) for several years city engineer and manager of the Light and Water Department, Lompoc, Calif., died there on November 19. His age was 69. Earlier Mr. Betaque had been associated with the Washington Water Power Co., Spokane, Wash., and the U.S. Shipping Board Emergency Fleet Corp. Later he was plant engineer and chief engineer of the Celite Co., and for some time was engaged in private practice. He was graduated from the State College of Washington.

David Richard Blakelock (Jun. M. '50) of Pittsburg, Calif., was killed in action in Korea on October 19. He was 26. Lieutenant Blakelock was serving in the Corps of Engineers. He graduated from Texas A. & M. College, where he was a member of the ASCE Student Chapter.

Frank Hartman Forney (M. '50) former district engineer for the Corps of Engineers, at Buffalo, N.Y., was killed in action in Korea, on November 29, at the age of 44. He was commanding an Engineer Combat Group. A graduate of West Point in 1929,

Col. F. H. Forney

Mr. Forney later received a civil engineering degree from the University of California. His assignments in the Corps of Engineers included service at the Raritan Arsenal, N.J., Corozal, C. Z., and in the Duluth District. Subsequently he was assistant professor of military science and tactics at Johns Hopkins University and executive officer of the Engineer Board at Fort Belvoir, Va., and served in various capacities abroad. Colonel Forney became chief of the Repairs and Utilities Division of military construction in Washington.

Frederick Calvin Davis (M. '27) construction engineer for Gladding, McBean & Co., of San Francisco, Calif., died recently, at the age of 88. Upon his graduation from the University of Michigan in 1888, Mr. Davis entered the employ of the city engineer of Chicago, Ill. Except for several years with the Pacific Clay Products organization and the city of Lincoln, he had been employed by Gladding, McBean & Co. since 1890.

(*Continued on page 74*)

At last! an all-material, heavy-duty car unloading team!

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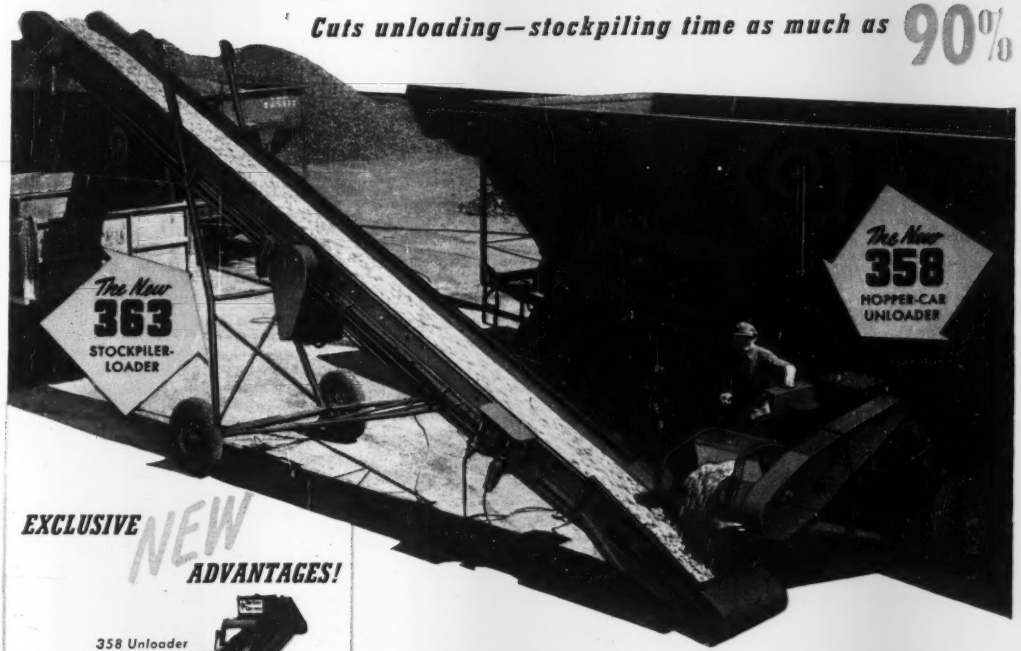

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BARBER-GREENE COMPANY
AURORA, ILLINOIS

Deceased

(*Continued from page 72*)

Thomas Grover Dunn (Assoc. M. '28) in the design section of the Corps of Engineers at Louisville, Ky., died at Jeffersonville, Ky., on December 2, at the age of 64. For approximately 20 years Mr. Dunn worked on the construction of Mississippi River levees and drainage projects in Illinois and Missouri. Later he became county superintendent of highways for Jackson County, Illinois. He also maintained a general consulting practice.

Henry James Eder (M. '97) of Cali, Colombia, died some time ago, though word of his death has just reached the Society. For many years Mr. Eder designed and superintended construction of sugar houses and coffee furnaces in Colombia. He also aided in the development of irrigation facilities, public roads, and other improvements in that country.

Harry Aurelius Gerard (Assoc. M. '35) for a number of years district airport engineer for the Civil Aeronautics Administration, at Louisville, Ky., was killed in an airplane crash near Frankfort, Ky., on December 4. His age was 56. He received his engineering training at Cooper Union. After two years of military service during World War I, Mr. Gerard became assistant engineer and superintendent of bridge maintenance for the New Jersey State Highway Department. He had been employed in a consulting capacity by several transportation bureaus in New York and New Jersey. In 1940 he became connected with the CAA.

Richard Fountaine Maury (M. '26) chief engineer for the Comision Mixta Argentina-Boliviana Joint Railway, at Buenos Aires, Argentina, died there recently. He was 65. In 1907 Mr. Maury went to Argentina as civil engineer for J. G. White & Co., of New York. About 1910 he became engaged by the State Railways and remained there until his death. His most important work was location, planning, and construction of the railway from Salta to Socompa. He was a Virginia Military Institute graduate.

Daniel Robert McFarland (M. '30) of San Francisco, Calif., died there recently, at the age of 59. Mr. McFarland had been associated with the Federal Power Commission, at Denver, Colo.; Guy F. Atkinson, of San Francisco, Calif.; and the Rogue River Valley Canal Co., at Medford, Ore. Earlier he acted as resident engineer on the San Gabriel project and the Don Pedro Dam and powerhouse construction.

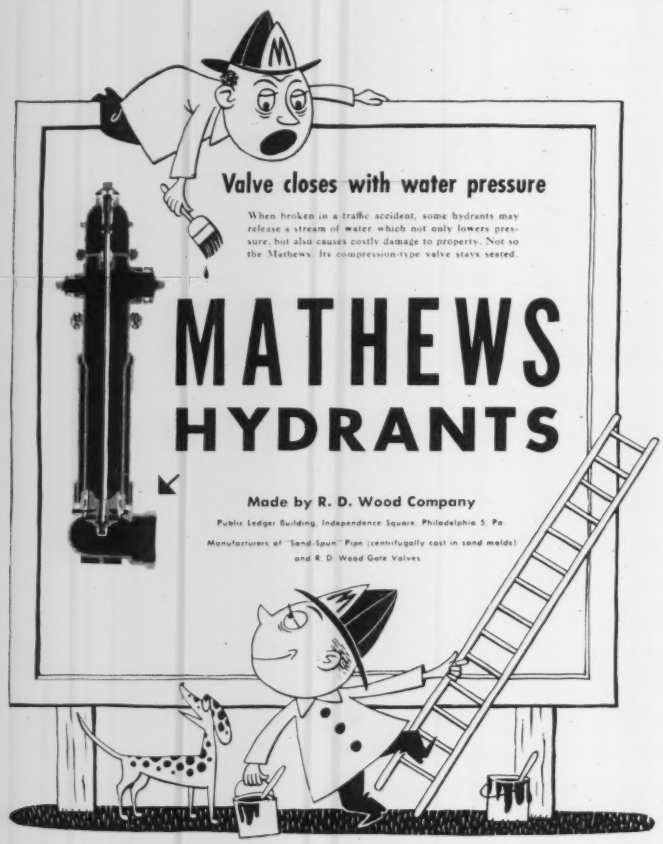
Thomas Carlyle Morris (M. '19) manager of construction of the Solvay Process Co., at Hopewell, Va., died in Minneapolis, Minn., on December 25. He was 64. Upon his graduation from the University of Minnesota in 1908, Mr. Morris entered the employ of the U. S. Ordnance Department, at Washington, D.C. From 1909 to 1920 he was resident engineer for the United States on construction of the Panama Canal. He became connected with the Solvay Co. in 1926.

John McLeod Mudie (M. '23) of Highland Park, Mich., died on December 21. His age was 63. In 1901 he graduated from the Royal Military College of Canada. During his career Mr. Mudie had been engaged by the Buffalo, Rochester & Pittsburgh Railway; the Canadian Department of the Interior; and the Detroit United Lines.

Walter Edwin Noble (Assoc. M. '02) retired deputy city engineer, of Fall River, Mass., died on September 11, at the age of 79. He was educated at the Massachusetts Institute of Technology. For some time Mr. Noble worked in the division of engineering of the Public Works Department at Fall River, where he successively acted as special assistant engineer on water supply, assistant engineer, and in 1931 deputy city engineer. He retired from the latter position in 1940.

George Alvin Nordgren (Assoc. M. '26) Chicago, Ill., consultant, died some time ago, though word of his death has just reached Society Headquarters. His age was 54. Mr. Nordgren had been associated with E. C. & R. M. Shankland, Chicago civil engineers; the E. P. Strandberg Co., in Chicago; and the U. S. Navy. In private practice since 1922 Mr. Nordgren specialized in the contracting and building field.

Clarence Bristol Osborne (Aff. '14) with the Raymond G. Osborne Testing Labora-


Valve closes with water pressure
When broken in a traffic accident, some hydrants may release a stream of water which not only lowers pressure, but also causes costly damage to property. Not so the Mathews. Its compression-type valve stays seated.
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tory, at Los Angeles, Calif., died some time ago though notice of his death has just been received at Headquarters. He was 68 and a graduate of Stanford University. At one time Mr. Osborne was chief geologist in charge of the testing laboratory of the California Highway Commission. He also served the Midwest Refining Co. as field geologist, assistant chief geologist, and chief geologist. In 1923 he established a consulting practice.

Frank Alfred Randall (M. '17) consulting structural engineer, of Chicago, Ill., died in Evanston, Ill., on December 2, at the age of 67. Since 1923 Mr. Randall maintained his own firm, now Frank A. Randall & Sons. He was employed by the Chicago Park District, where he had charge of the construction of the Outer Drive improvements. For several years he acted as chief engineer for Morey, Newgard & Co., in Chicago. He received his engineering training at the University of Illinois.

Herman Schorer (M. '42) since 1934 president of the Borsari Tank Corp. of America, with headquarters in New York City, died at his home in Valhalla, N.Y., on December 20. He was 58. A graduate of the Polytechnic Institute of Zurich, Switzerland, Mr. Schorer worked abroad for many years as a civil engineer. He came to the United States in 1920 and was engaged by the New York Central Railroad, the San Joaquin Light & Power Corp., and various municipal and federal agencies.

Roy Whittaker Smarr (M. '26) civil engineer and real estate operator of Charleston, W. Va., died on November 20, at the age of 64. Mr. Smarr was employed as a civil engineer by the Kanawha City Co., and with his brother operated the Kanawha Development Co. He received his degree in civil engineering from the University of Kentucky in 1909.

Francis Betts Smith (M. '07) consulting engineer, of San Francisco, Calif., died some time ago, though word of his death has just reached the Society. He was a graduate of Lehigh University. Mr. Smith practiced engineering for a number of years, specializing in the design and construction of reinforced concrete structures.

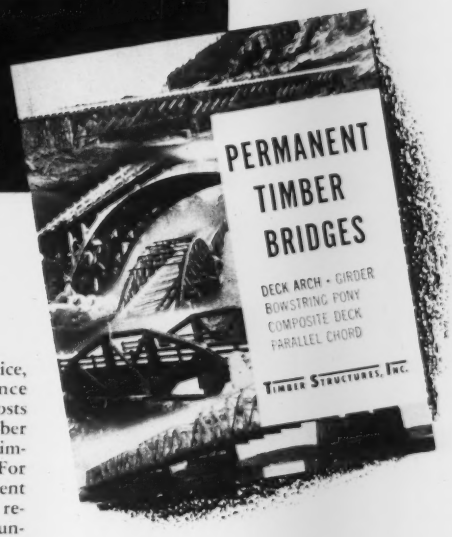
George Albert Tilton, Jr. (Assoc. M. '19) for the past 17 years assistant construction engineer in the construction department of the California Division of Highways, at Sacramento, died recently. He was 59. Mr. Tilton entered the service of the Division of Highways in 1918 as chief of party on surveys in the San Luis Obispo District and became assistant district engineer in 1931. An authority on highway drainage, he co-authored the handbook entitled, *California Culvert Practice*.

Alfred Everett White (Assoc. M. '35) for a number of years division engineer for the State Highway Department, at Keene, N. H., died on December 1, at the age of 62. He received his engineering education at Columbia University.

Philip Brundage Windsor (M. '09) of Fort Lauderdale, Fla., died there recently.

(*Continued on page 76*)

The way to Low Bridge Costs... with permanent bridges of engineered timbers



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Glued Laminated Members for Dimensional Stability

Primary structural members of Timber Structures bridges are glued laminated timbers, formed of select kiln dried Douglas fir, joined under pressure by permanently waterproof glues stronger than the wood itself. Thus literally "shop grown" to the exact specifications of the designer, these members are not subject to dimensional changes and seasoning action.

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Ask for Literature on Timber Bridges

An illustrated folder has just been published showing the five basic bridge types of Timber Structures, Inc. — deck arch, bowstring truss, parallel chord truss, composite deck and girder. Typical applications are shown, together with detail drawings of each type. A copy of this folder is yours for the asking. Get it from your nearest Timber Structures representative, or fill in and mail coupon.

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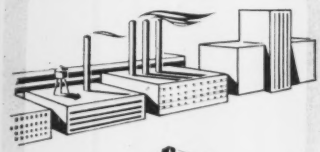
Whatever your project, it will not be "out of our line," for Merritt-Chapman & Scott's vast experience is based on a broad range of construction assignments. In the pulp and paper industry, for example, M-C & S has put its specialized skills to work building new plants or additions for 12 companies within the past 10 years. M-C & S is now starting work on two additional paper mills.

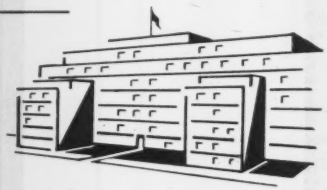


MARINE

Now at work, among others, on the substructure for the 4.3 mile long Chesapeake Bay Bridge, M-C & S's diverse construction skills have helped build many of America's major bridges. Recent projects include the Mystic River Bridge, Boston, the Mississippi River Bridge at Memphis, and the Delaware Memorial Bridge near Wilmington, Del., for which M-C & S constructed the largest caisson in surface area ever built.

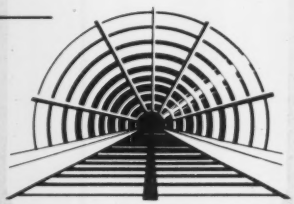
BUILDING

Merritt-Chapman & Scott's ability to produce the highest standard of work at the lowest possible price has been sharpened by wide experience. In the hospital field alone, M-C & S has just completed two projects for the Veterans Administration and is now constructing a third VA hospital at West Haven, Conn.



HEAVY

Tunnel construction calls for a combination of heavy muscle and needle-point precision, demands absolute mastery of every building skill. M-C & S has built three of the nine trench-type tunnels in the United States and is at work on a fourth. As a builder of piers, M-C & S is equally well known. Latest such project is the new Mystic Pier terminal, Boston.



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CLEVELAND • BOSTON • NEW LONDON

Deceased

(*Continued from page 75*)

His age was 72. Upon his graduation from Cornell University, Mr. Windsor joined the Cuba Co., where he served as transitman and assistant engineer in charge of bridges and track construction of the Eastern Division of the Cuba Railroad. In 1902 he became a member of the firm of Marx & Windsor, at Camaguey and Havana. As a consulting engineer, he had charge of many railroad projects in that country from the design through the construction stage.

NEWS OF ENGINEERS

E. G. Nielsen, for the past five years regional planning engineer for the U.S. Bureau of Reclamation, at Boulder City, Nev., has been named assistant director of Region 3, with headquarters in Boulder City. Region 3 embraces southern California and the lower Colorado River watershed. Joining the chief engineer's staff in the Bureau's Denver office as designer in 1934, Mr. Nielsen has served successively as head of the planning office at Salt Lake City, Utah, chief of the hydrology division in Denver, Colo., and regional planning engineer at Boulder.

E. G. Nielsen

Louis Mitchell, dean of the L. C. Smith College of Applied Science at Syracuse University since 1922, has retired after 40 years on the Syracuse faculty.

John C. Bumstead, who has been associate editor of *Engineering News-Record*, New York City, was recently named assistant director of the Ohio River Valley Water Sanitation Commission, with headquarters at Cincinnati.

Dabney O. Elliott, president of the Beach Erosion Board in Washington, D.C., has resigned to accept the position of deputy director of civil defense in Illinois.

John S. Marshall has retired as engineer of surveys and plans for the Colorado State Highway Department, at Denver, after more than 31 years of service. Mr. Marshall's responsibilities have involved the construction of highways, costing upwards of $200,000,000. Attaining the rank of lieutenant colonel in the Corps of Engineers during the recent war, he is commanding officer of the 384th Engineering Construction Group—a unit affiliated with the Organized Reserve Corps and sponsored by the Highway Department. He has served the Society as president of the Denver Section.

(*Continued on page 78*)

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Saw 12 feet per minute in Asphalt or 5 feet per minute, 1 inch deep, in cured limestone Concrete. With Clipper you can saw up to 6½ inches deep. Concrete Sawing is Practical and Profitable because Clipper Concrete Saws are Built with the experience of World's Largest Manufacturer of Masonry Saws.

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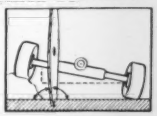

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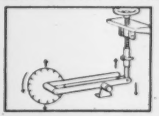
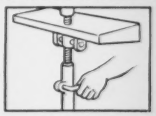
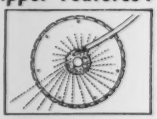


2. Positive Screw Feed Instant control raises or lowers blade smooth, easy.



3. Adjustable Depth Lock Set this handy stop for whatever depth desired.



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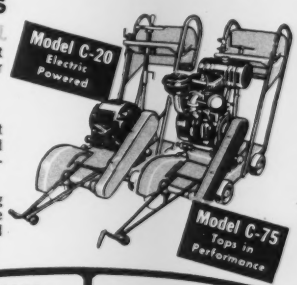
Clipper Concrete Saws ***CUT*** through the toughest concrete, wherever patches, trenches, openings or contraction joints are needed.



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Regardless of the Material you plan to Cut...Limestone, Flint, Gravel, Aggregate Concrete Green or Well Cured, or Asphalt . . . there's a Clipper Diamond Blade to cut fast and economically.

PATCH Saw clean straight lines, break smooth — Size and shape make no difference

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DRIVES—WALKS Prove the job can be small and still make concrete sawing profitable

Serving the World as the World's Largest Manufacturer of Masonry Saws

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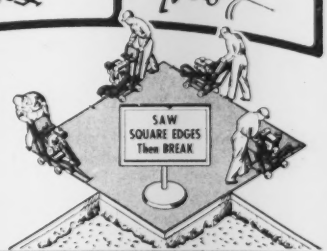
Completely descriptive literature tells the value of Clipper Concrete Saws. Get this information now! Tell us what you plan to cut!



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News of Engineers

(*Continued from page 76*)

Paul W. Holstein, until recently on duty as a commander, Civil Engineer Corps Reserve, in the Public Works Department of the 13th Naval District, Seattle, Wash., is now associated with the Washington Steel & Welding Co., of Tacoma, as sales engineer.

Paul Beerman has been named city hydraulic engineer of San Diego, Calif. In the San Diego engineering department for over 20 years, Mr. Beerman has been serving as assistant hydraulic engineer.

Robert O. Grimes is now project engineer for Farnsworth & Chambers Co., Inc., at Houston, Tex.

William M. Robinson, Jr., colonel, CE-Res., who has been stationed in Washington, D.C., with the Army Disability Review Board, has retired and plans to make his home at Quincy, Fla.

Maurice A. Shapiro, engineering research associate for the American Public Health Association, New York, N.Y., has accepted the appointment of professor of sanitary engineering in the graduate school of public health at the University of Pittsburgh, Pittsburgh, Pa.

Walter M. Sanger, for some time assistant division engineer, General Services Administration, U.S. Public Buildings, at San Francisco, Calif., has retired.

Carl H. Cotter, rear admiral, CEC, USN (Ret.), since May 1949 president of the Merritt-Chapman & Scott Corp., of New York, N.Y., has resigned from that position to devote his time to activities connected with the national preparedness program. Admiral Cotter will be retained by Merritt-Chapman & Scott as a consultant. **Raymond F. Kopp** will become president of the corporation and **Ralph E. DeSimone** executive vice-president and general manager.

Carl H. Cotter

J. J. Polivka, consulting engineer of Berkeley, Calif., and former research associate in civil engineering at the Engineering Materials Laboratory of the University of California, has been appointed visiting lecturer in architecture for the winter quarter in the department of art and architecture at Stanford University.

R. L. Eason announces the establishment of the consulting firm of R. L. Eason & Associates, at 5423 Southwest Avenue, St. Louis, Mo.

James A. Anderson, commissioner of the Virginia State Highway Department, Richmond, and **Bertram D. Tallamy,** superintendent of public works for the State of New York, were elected president and vice-president, respectively, of the American Association of State Highway Officials at its recent convention.

W. H. Woleben has been transferred from the general sales office of the Chicago Bridge & Iron Co., Chicago, Ill., to the Houston, Tex., sales office.

William P. Jones, Jr., lieutenant colonel, Corps of Engineers, left his assignment as officer-in-charge of the San Antonio suboffice of the Galveston District in June 1950, to join the newly formed Fort Worth District of the Corps, of which he is at present executive officer. In the December issue, it was erroneously stated that Colonel Jones was still in charge of the San Antonio suboffice.

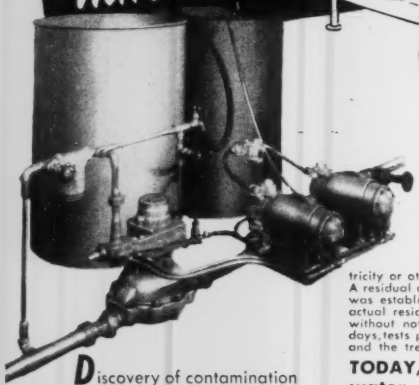
C. F. Hamlin, until recently senior bridge engineer for the California Division of Highways, at Sacramento, has joined the Bailey Bridge Equipment Co., with headquarters in San Luis Obispo.

Earnest Boyce, chairman of the department of civil engineering and professor of municipal and sanitary engineering at the University of Michigan, has been appointed to the board of directors of the Engineering Society of Detroit, succeeding the late George W. McCordic.

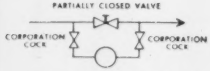
Walter E. LaBelle, since 1940 assistant to the general manager of the fabricated steel construction division, of the Bethlehem Steel Co., Bethlehem, Pa., has been appointed assistant general manager of the division there. Mr. LaBelle has worked in the engineering department of Bethlehem for the last 20 years.

CHLORINE DIOXIDE TREATMENT

A PAINLESS CURE for a Sick Water Works



PARTIALLY CLOSED VALVE



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Robert H. Meade, captain, CEC, USN, has assumed new duties as director of Naval Petroleum Reserves in Washington, D.C. Captain Meade will supervise the Navy Department's four petroleum reserves and three oil shale reserves in the United States and Alaska. Before going to the Office of the Director of Petroleum Reserves last July, he served as assistant chief of the Bureau of Yards and Docks for Business Management.

U.S. Navy Photo

Capt. R. H. Meade

C. A. Willson, research engineer for the American Iron and Steel Institute, New York City, has been reelected to the executive committee of the Building Codes Correlating Committee of the American Standards Association.

Henry J. Brunnier, consulting structural engineer, of San Francisco, Calif., recently received an award as the year's outstanding member of the building and construction industry in northern California, during a dinner given in his honor by the industry members at the Fairmont Hotel.

Maurice Housecroft, after serving the Utah State Road Commission, at Salt Lake City, for 25 years has retired as chief bridge engineer.

Wilfred L. Karrer, construction engineer for the U.S. Bureau of Reclamation at Lewiston, Idaho, has been transferred to the Yakima project in eastern Washington, in a similar capacity.

H. J. McKenzie, formerly chief engineer of the Southern Pacific Lines in Texas and Louisiana, at Houston, Tex., is now executive vice-president of the St. Louis, Southwestern Railway Co., with headquarters in St. Louis, Mo.

Robert C. Kennedy has been appointed to the post of chief engineer of the East Bay Municipal Utilities District, in Oakland, Calif., to coordinate the engineering functions of the district and supervise design and construction of the sewage disposal project now underway. Mr. Kennedy has served the district for 25 years, more recently as assistant chief engineer and assistant general manager.

Wayne S. Moore, colonel, Army Corps of Engineers, has retired from active duty after more than 30 years of service. Colonel Moore's latest assignment was with the American Battle Monuments Commission in Paris.

Willard F. Babcock, associate professor of civil engineering at North Carolina State College, Raleigh, has been named national vice-president and councilor of Chi Epsilon from the new southeast district. **John B. Babcock,** professor of railway engineering at the Massachusetts Institute of Technology, was erroneously reported appointee to these posts in the January issue of CIVIL ENGINEERING.

Howard Phelps, retired Washington State College professor, has been named acting county engineer of Whitman County (Washington), at Colfax. Prof. Phelps was on the Washington State College faculty for 31 years.

ASCE members recently installed as officers of the Structural Engineers Association of Oregon include **R. Evan Kennedy,** who is with the consulting firm of Cooper & Rose, Portland, president; **Guy H. Taylor,** partner in the consulting concern of Moffatt, Nichol & Taylor, Portland, vice-president; and **James R. Griffith,** dean of engineering at the University of Portland, secretary-treasurer.

F. N. Hveem, for a number of years with the California Division of Highways, at Sacramento, has been made construction engineer there.

S. W. Lowden, until recently district engineer for the California Division of Highways, at Bishop, Calif., is now district engineer at San Bernardino.

Dario Travaini, previously superintendent of water production and sewage treatment in the Department of Public Works, of Phoenix, Ariz., has been named superintendent of the recently reorganized water department there. **Perley M. Lewis,** of Phoenix, has been made his assistant and field engineer.

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TABLE OF ASTM A305 SPECIFICATIONS

		NOMINAL DIMENSIONS ROUND SECTIONS			REQUIREMENTS OF DEFORMATIONS		
Bar No.*	Unit Wt. Lbs. Ft.	Diameter-Inches Decimal	Cross Sectional Area Sq. Inches	Perimeter	Max. Avg. Spacing In.	Min. Height Inches	Max. Gap, Inches°
2†	0.167	0.250	0.05	0.785	.. ..	.. .	.. ..
3	0.376	0.375	0.11	1.178	0.262	0.015	0.143
4	0.668	0.500	0.20	1.571	0.350	0.020	0.191
5	1.043	0.625	0.31	1.963	0.437	0.028	0.239
6	1.502	0.750	0.44	2.356	0.526	0.038	0.286
7	2.044	0.875	0.60	2.749	0.612	0.044	0.334
8	2.670	1.000	0.79	3.142	0.700	0.050	0.383
9‡	3.400	1.128	1.00	3.544	0.790	0.056	0.431
10‡	4.303	1.270	1.27	3.990	0.889	0.064	0.487
11‡	5.313	1.410	1.56	4.430	0.987	0.071	0.540

*Bar numbers are based on the number of ⅛ inches in the nominal diameter of the section.
†Bar number 2 in plain rounds only.
‡Bars numbered 9-10-11 correspond to former 1" sq., 1⅛" sq., and 1¼" sq. sizes, and are equivalent to those former standard bar sizes in weights and nominal cross-sectional areas.
°Chord of 12 ½% of Nom. Perimeter.

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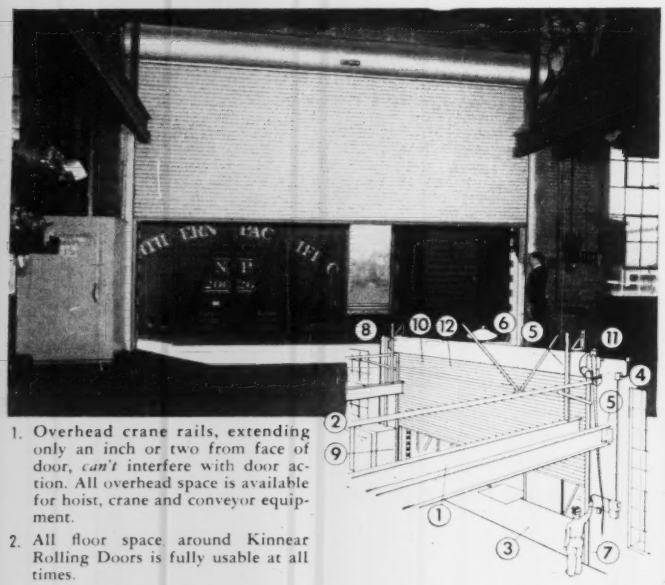
No other doors offer all these advantages



1. Overhead crane rails, extending only an inch or two from face of door, *can't* interfere with door action. All overhead space is available for hoist, crane and conveyor equipment.
2. All floor space around Kinnear Rolling Doors is fully usable at all times.
3. No sacrifice of space on narrow loading platforms with Kinnear Rolling Doors. They need no room inside or outside the building for opening and closing action.
4. Windows can be placed right next to Kinnear Rolling Doors . . . they are never blocked off when the doors are operated.
5. Supports or other superstructure can be placed close to sides, front and top of Kinnear Rolling Doors —inside or outside the building.
6. Light from overhead fixtures is never blocked off by Kinnear Rolling Doors, they coil compactly above the opening.
7. Wind can't blow Kinnear Doors back and forth, or damage them. Edges are anchored in steel tracks from floor to ceiling!
8. Kinnear Rolling Doors open straight upward, coiling completely out of the way of traffic, safe from damage.
9. The opening is cleared from jamb to jamb and floor to lintel. No projecting edges or parts to obstruct opening.
10. A continuous curtain of strong interlocking steel slats gives you extra protection against fire, theft, intrusion, wind, weather and accidental damage.
11. Kinnear smooth, upward action is ideal for time-saving motor operation, with convenient remote control. Rugged Kinnear motor operators do the trick.
12. Kinnear's interlocking steel slat curtain is not only more rugged and longer lasting, but permits any number of slats to be individually replaced if accidentally damaged. Lower maintenance costs!

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RECENT BOOKS

Geophysical Studies in the Antarctic

Prepared under the Office of Naval Research by T. C. Poulter, this report is of interest to those who contemplate seismic studies of ice fields, whether shelf ice, continental ice, ice caps, glaciers, permafrost, or ice- and snow-covered land areas. It deals primarily with the geophysical aspects of the second Byrd Antarctic expedition. Among the sections covered are sound absorption and transmission phenomena, seismic equipment and field procedure, methods of determining depth, physical structure of the shelf ice, snow tremors and geysers, ice movement, surface elevation, tide cracks, and water current. Stanford Research Institute, Stanford, Calif., 1950. 109 pages, $4.

Foundations of Structures

Written for civil engineering students, *Foundations of Structures* covers the planning and dimensioning of foundations encountered in ordinary engineering practice. The author, C. W. Dunham, shows how to obtain and interpret data regarding soils, how to plan the support of a structure upon them, and how to devise means for the construction of the foundation. A wide variety of foundation problems is illustrated, and there is an extensive treatment of bridge piers and abutments. (McGraw-Hill Book Co., New York, Toronto, London, 1950. 679 pages, $7.50.)

(A) Manual for the Slide Rule

Prepared as a text for short courses covering the use of the scales on modern duplex type slide rules, *A Manual for the Slide Rule*, by P. E. Machovina, deals with the logarithmic theory on which the scales are based as well as the principles of operation. Practice problems are included at the end of the text. (McGraw-Hill Book Co., New York, London, Toronto, 1950. 78 pages, 75 cents.)

Massivbogen und Viadukte

H. Fiesinger's long experience in design and construction is utilized in his book, *Massivbogen und Viadukte*, which deals with the reinforcement and repair of massive arches and viaducts, including procedures and their application to specific projects. Detailed tables and sketches show design factors (moments, forces, etc.) which characterize various bridges in Germany. (Verlag von Wilhelm Ernst & Sohn, Berlin, 1950. 88 pages, 9 D.M.)

The Nomogram

A discussion of the general mathematical theory of computation charts is combined with practical directions for their construction and use in *The Nomogram* by H. J. Allcock and J. R. Jones. Details of construction are emphasized and examples are given illustrating the various methods employed. The connection between intersection and alignment nomograms, and a new appendix dealing with the formation of the basic determinant for nomograms of the third class are presented in this fourth edition, which has been revised by J. G. L. Michel. Pitman Publishing Corp., New York, Toronto, London, 1950. 238 pages, $3.75.

Underpinning, Its Practice and Applications

Devoted to technical descriptions of underpinning methods and applications for foundation construction, this volume by E. A. Prentis and Lazarus White also contains an introductory treatise on soil mechanics and appendixes covering specifications, legal aspects, and rates of pay. New chapters on the raising and moving of heavy structures and on the recent renovation work done on the White House are included in this second revised edition. Columbia University Press, New York, N.Y., 1950. 374 pages, $10.

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STRUCTURAL ENGINEER. Student M. ASCE; 25; single; immune to draft; graduate, University of Oklahoma, January 1951; willing to travel. Has worked for Oklahoma State Highway Department, steel fabrication shop, house construction and real estate sales. Interested in structural design, heavy construction, and sales engineering. C-649.

CIVIL ENGINEER, Jun. M. ASCE; B.C.E. University of Virginia, Virginia license; veteran; married; 1 year experience as construction engineer, estimator and expediter; desires position with future. Location desirable Northeastern United States. C-650.

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PROJECT ENGINEER; Assoc. M. ASCE; age 49; graduate; 28 years' experience including complete charge of design and construction of industrial buildings, bridges, and heavy engineering structures as chief structural, project, and resident engineer. Contract administration; client relations; design; estimating; specifications; negotiating; cooperating with consultant. C-651.

CIVIL ENGINEER; Assoc. M. ASCE; registered professional engineer; age 41; 21 years' varied experience including design, layout and supervision of construction, building projects, water works, sewerage systems; also chemical and explosive plant layout. Desires position with consulting engineer with possibilities of partnership or construction company on salary-bonus basis. Location optional. C-652.

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HYDRAULIC ENGINEERS

Qualified by actual experience to make basis engineering determinations and to prepare studies, estimates, specifications, and designs for Hydroelectric projects.

Salaried position commensurate with experience; location in Boston office of leading engineering concern. In reply please state educational qualifications, work experience, and salary desired.

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water treatment plants, reservoirs, dams, and miscellaneous sanitary and hydraulic municipal projects. Work also includes investigations, studies and reports for consulting firm. Location, Massachusetts. Y-4579.

ENGINEERS. (*a*) Civil or Mechanical Engineer, graduate, with broad experience in design and preparation of plans and specifications for industrial facilities, utility systems, and airfields. Will assist in the supervision of architect-engineers contracts for military construction and will involve review of plans for conformance with established design criteria and directives. Must be qualified to deal with representatives of military establishments and architect-engineer firms concerned with the various projects. Salary, $5,400–$6,400 a year. (*b*) Architect, graduate architect, capable of preparation of master plans for military installations. Should be capable designer and have had a broad experience in preparation of layouts and the development of plans for large areas or municipalities. Salary, $4,600–$5,400 a year. Location, Washington, D.C. Y-4652

ENGINEERS. (*a*) Instructor or Assistant Professor, civil graduate, with advanced degree and some practical experience in structural design, to teach undergraduate courses and later more advanced structural courses. Some interest in structural research, primarily experimental, would be desirable. (*b*) Research Assistant or Associate, civil graduate, to assist in structural research, primarily experimental. Some experience in laboratory desirable, for assistant, and mandatory for associate. Opportunity to work for master's or doctor's degree. Location, central New York State. Y-4675

ENGINEERS for airport construction project. (*a*) Chief Civil Engineer for pavement design and soils analysis. Salary, $9,360 a year. (*b*) Project Engineer. Salary, $8,580 a year. (*c*) Sanitary Engineer. Salary, $7,800 a year. (*d*) Structural Design Engineer. Salary, $7,800 a year. (*e*) Chief Estimator and Specification Writer. Salary, $7,800 a year. (*f*) Soils Engineer. Salary, $7,800 a year. (*g*) Senior Draftsmen. Salary, $5,720 a year. (*h*) Equipment Superintendent. Salary, $8,580 a year. (*i*) Assistant Superintendent (heavy). Salary, $6,240 a year. (*j*) General Superintendent. Salary, $9,360 a year. (*k*) Safety Engineer, junior. Salary, $5,970 a year. In addition to the above salaries, there are proportionate cash subsistence and quarters allowances. Duration, about 2 years. Location, Foreign. Y-4687

ENGINEERS. (*a*) Maintenance Engineer, civil graduate, 45–55, with considerable experience in the maintenance of asphalt and concrete highways. Salary, $10,000 a year. (*b*) Superintendents, 3. Equipment Superintendent to take complete charge of maintenance and operation of road building equipment, and 2 Field Superintendents for the construction and repair of highways. Salaries, $7,000–$8,000 a year. Location, East. Y-4699

ENGINEERS. (*a*) Structural Detail Draftsmen. Must have had experience in the making of detailed shop drawings for the fabrication of structural steel for buildings, bridges and similar structures. (*b*) Structural Detail Checkers with experience in checking of such drawings. Positions are permanent, excellent working conditions and opportunities. Salaries open. Location, California. Y-4728

ENGINEERS. (*a*) Structural Engineers with broad experience in design of bridges and other heavy structures of steel and reinforced concrete. Must be capable of assuming responsible charge of important elements of major projects. Excellent opportunities for advancement in the organization of a major consulting engineer located in the East. (*b*) Field Engineers experienced in design and control of asphaltic concrete mixtures and the construction of bituminous base courses and asphaltic concrete pavements, for field inspection on construction in the East. Y-4732

ENGINEERS. (*a*) Engineering Trainee, 21–25, B.S. degree. Will be required to attend Spanish classes. Must be physically able to work in places of considerable height and in tight quarters such as inside drums and towers. Will be trained in inspection and testing of all types of company pressure vessels and metal equipment, calculating and checking design of pressure vessels, heat exchangers, piping and boilers, etc. Must be willing to travel extensively. Salary, $5,700–$6,600 a year. (*b*) Engineer Trainee, 22–26, B.S. in C.E., with up to 2 years' experience. Spanish desirable. Will run elevations and make locations of wells, roads, and other installations, make cost estimates, designs, technical calculations of new installations, etc. Salary, $6,840 a year. (*c*) Engineer Trainee, 22–30, civil engineering degree, with 1 or more years' experience preferred. Spanish desirable. Work will include general layout, design, and construction of houses, industrial buildings, plants, pump stations, and tank farms. Specific work pertaining to municipal engineering. Salary, $5,700 a year. Location, South America. Y-4734

ENGINEERS. (*a*) Senior Engineer, 33–38, civil degree, with 10 to 15 years' experience in general types of engineering pertaining to construction of industrial and residential areas and marine structures, water supply, and sewerage treatment plants. Should be qualified office administrator. Will be responsible for preparing and for processing necessary paper work including budgets, estimates, drafting, cost data, statistics, and correspondence. Salary, $8,640–$9,600 a year. (*b*) Senior Engineer, 33–38, civil degree, with 10 to 15 years' experience in engineering pertaining to soil mechanics. Will study, design, and inspect projects involving supporting value of soils, pile capacities, stability of slopes, roadways, and embankment dams. Specific duties will be concerned with working out solution to methods of operation in the Delta areas. Salary, $8,640–$9,600 a year. Spanish desirable. Location, South America. Y-4736

STRUCTURAL DESIGNER, 30–40, single preferred, with civil or mechanical degree, and 8 years' structural design and drafting experience. Structural designer with refinery experience preferred. Will design, draft, and check structures of steel, reinforced concrete, or timber, including mill buildings, trestles, pipe supports, piers, wharves tanks, etc. Will make necessary field investigations of existing structures and determine safe loads as well as make recommendations for necessary repairs. Salary, $7,320–$8,280 a year. Location, Netherlands East Indies. Y-4738

EVALUATION DIRECTOR, 45, civil or mechanical graduate, for U.S. Navy, to evaluate equipment, structures, material and process used in Navy shore establishments and by construction battalions. Salary, $8,800 a year. Location, California. Y-4755

FIELD ENGINEER with considerable experience in hard rock tunneling. Will supervise and certify construction work done by contractors. Salary open. Location, East. Y-4774

FIELD CONSTRUCTION SUPERVISOR for work in connection with the remodeling and rebuilding of retail stores throughout the country. Graduate architect desired. Some practical building construction experience desirable. Single status preferred, as position requires being away from headquarters almost constantly. Headquarters, Ohio. Y-4778(*a*)

CHIEF STRUCTURAL ENGINEER, 35–45, to head up a structural design department for engineering company in the building field. Salary, $8,000–$10,000 a year. Location, New York, N.Y. Y-4787

(Continued on page 86)

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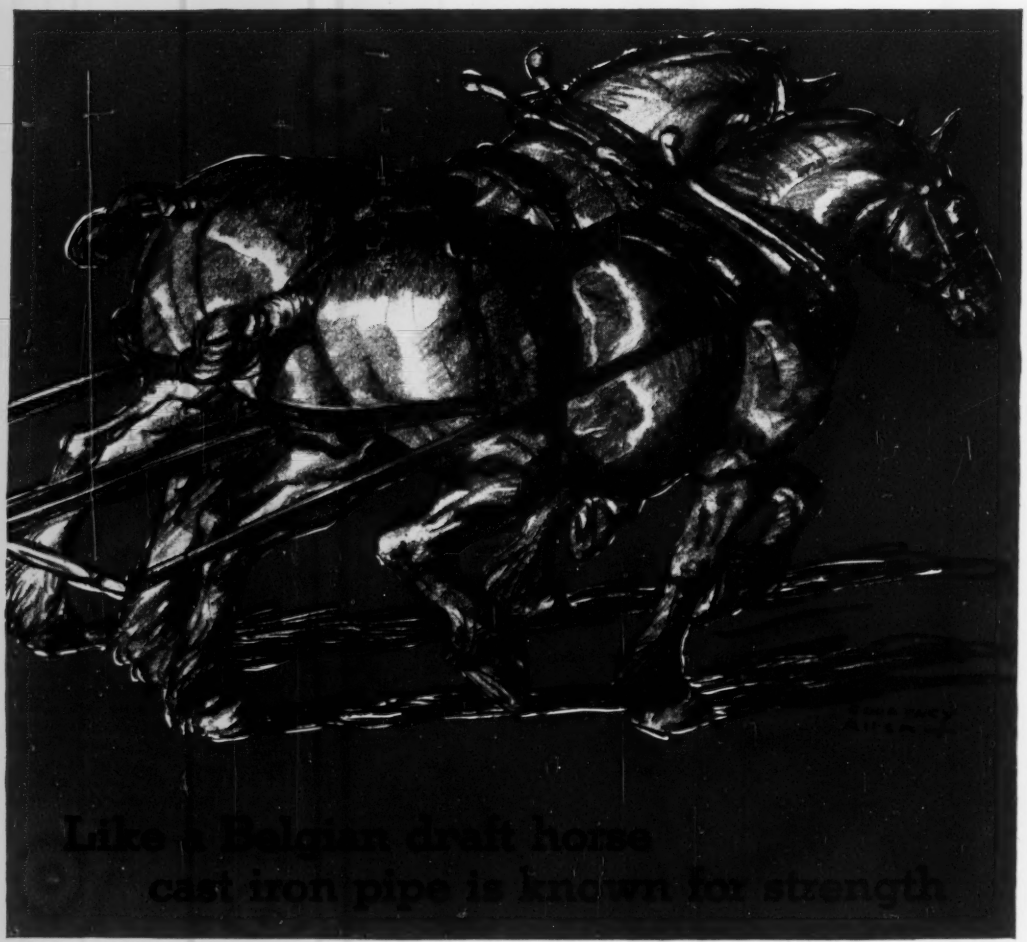

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When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

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Positions Available

(Continued from page 83)

AREA ENGINEER, 35–40, civil graduate, capable of taking complete charge of construction contracts for the owner on chemical plant construction. Must be extremely cost conscious. Salary, $8,000 a year. Location, East. Y-4790.

ESTIMATOR, 40–50, civil graduate, to take complete charge of all estimating for large contractor on building and heavy construction. Salary $8,000–$10,000 a year. Location, Washington State. Y-4794.

BRIDGE ENGINEER, civil graduate, with at least 20 years' professional civil engineering experience, including 4 years in responsible charge of highway bridge design and 2 years in supervision of bridge construction, to act as principal assistant to the county engineer, with the responsibilities of technical and administrative head of the bridge engineering division. Duties involve the design, supervision of construction and maintenance of bridges and culverts in the county highway system. Salary, $6,500 a year to start. Location, New Jersey. Y-4796.

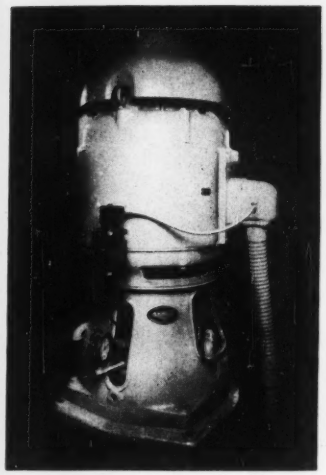
ENGINEERS. *(a)* Chief Engineer, graduate in city planning, with 15 years' experience in planning, design and administration, housing development, airports, road nets, technical installations, etc. Salary, $12,000 a year. *(b)* Architect, graduate of architectural school for city planning. Must have had 10 years' experience and be thoroughly familiar with planning, design, supervision, technical installation, housing and community development, airports, layouts, etc. *(c)* Architect, graduate of accredited school of architecture, with 10 years' experience in contemporary architecture, including planning, design and supervision, especially reinforced concrete underground structures. *(d)* Airport Engineer, graduate in civil engineering, with airport major or equivalent in experience. Should be thoroughly familiar with airport planning, design and construction. *(e)* Civil Graduate, with 10 years' experience in sanitation, sewerage, water works, soils, materials, planning, design and supervision. Location, Okinawa. Company will pay transportation both ways. No dependents will be permitted to accompany applicants. Will be covered by accident policy of $10,000, also Workmen's Compensation of $10,000. Applicants will be given 2 days per month leave to be accrued. Must sign 1-year contract, subject to renewal at end of year, dependent on conditions. Room and board in Army headquarters. Y-4798.

STRUCTURAL ENGINEERS. *(a)* Structural Engineer, state license, and about 5 years' experience contacting with contractors and estimate fabricated structural steel users. Sales personality. Knowledge of conveyors for factory buildings and highly fabricated light- and medium-weight structural steel products. Will be office engineer for manufacturer of fabricated structural steel products. Salary, to $12,000 a year. *(b)* Structural Detailer-Designer with about 3 years' experience detailing fabricated structural steel products. Capable of taking charge of engineering for manufacturer. Knowledge of fabricating practices. Informed about contacting customers. Will take charge of engineering department for a manufacturer of fabricated structural steel products. Salary, $6,000–$7,500 a year. Location, Illinois. R-7270.

GENERAL FIELD SUPERINTENDENT, civil engineering background, well experienced and competent to act as general engineering construction superintendent of steel plant. Able to operate with survey crews, supervise and check construction crews, thoroughly informed regarding foundations, steel construction for machinery installation and building trade. Knowledge of and ability to handle field construction changes and act as chief construction representative on job. Salary commensurate with experience. Location, Texas. R-7276.

STRUCTURAL ENGINEER, graduate, with experience in design and construction of reinforced concrete structures. Duties include technical assistance and promotion of reinforced concrete. Salary open. Location, Missouri. Y-4832.

GENERAL SUPERINTENDENT, steel plate, with about 3 years' experience supervising fabrication of structural steel and plate work. Knowledge of foundry and machine shop. Will be general superintendent of a structural steel fabricating shop operating own machine shop and foundry. Salary open. Location, Texas. R-7285(4).



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New Publications

Employment Reference Corrected. In the bibliography of recommended reading published with the article, "What Is the Right Job for Me," in the December 1950 issue, it was stated that the book, "Six Ways to Get a Job," by Paul W. Boynton of the Socony-Vacuum Oil Co., Inc., could be obtained free upon application to the author. This statement was in error. The volume is published by Harper & Brothers, New York, currently in a 1945 edition at $1.50. In April 1951, a third revised edition will be available at $2.

A pamphlet, "So You Want a Better Job," by Mr. Boynton is published by the Socony-Vacuum Co., Inc., New York, N.Y., and is distributed free by the company.

Public Works. Economic and social aspects of international collaboration in the building field are covered in a summary of the General Meeting of the delegates of the International Federation of Building and Public Works, held in Venice in September 1950. Inquiries concerning the summary, *Bulletin of the International Federation of Building and Public Works*, which is published in English, should be addressed to the Federation, 9 Avenue Victoria, Paris, France.

Survival Under Atomic Attack. Detailed instructions for surviving an atomic bomb raid without a Geiger counter, protective clothing, or special training is presented in an official government booklet, *Survival Under Atomic Attack*. Issued by the Civil Defense Office of the National Security Resources Board as Document 130, this simple, non-technical work is obtainable from the U.S. Government Printing Office, Washington, D.C., at 10 cents each. A 25 percent discount is allowed on orders in excess of 100 copies.

Highway Research. Material on anti-skid properties and experiments with powdered rubber constitute Bulletin No. 27 of the Highway Research Board. Also available from the Board is a special 110-page publication, consisting of the Report of the Committee on Roadside Development and special papers presented at the 29th annual meeting of the organization, which sells for $1.50. All inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, Washington, D.C.

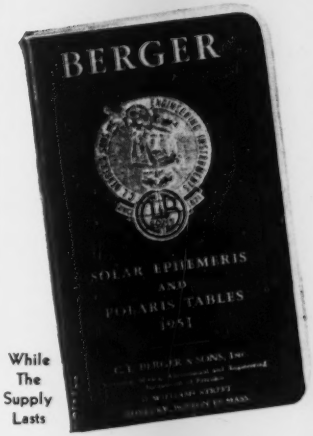
Civic Auditoriums. Many questions created by the relatively recent growth of public ownership of auditoriums are discussed in a pamphlet called *Municipal Auditoriums*. With the use of questionnaries, Farrel G. Symons has collected factual data about the construction, management, and operation of civic auditoriums throughout the country. Copies may be obtained from the Public Administration Service, 1313 East 60th St., Chicago 37, Ill., for $2.50 each.

Arkansas River Maps. A folio of maps of *The Arkansas River in Arkansas*, scaled at approximately 1 in. to 1 mile, shows the river's course in Arkansas from Little Rock to the mouth. The maps are for sale by the Vicksburg District, Corps of Engineers, U.S. Army, P.O. Box 60, Vicksburg, Miss., for 50 cents.

Airport Study. Present air transportation facilities, and a program for future development are considered in the *California Airport Study* by the Engineering Staff of the California Aeronautics Commission. The current publication is the first part of a trilogy which will form a complete aeronautical and economic analysis of the airports of the state. Copies may be obtained from the Printing Division, Documents Section, 11th and O Streets, Sacramento, Calif., for $2.50 plus tax.

Traffic Bibliography. A bibliography covering recent publications, compiled by the Transportation and Communication Department of the Chamber of Commerce of the U.S., called *Bibliography of Publications in the Field of Street and Highway Traffic*, is now available. Inquiries should be addressed to the Transportation and Communication Department, Chamber of Commerce of the U.S., Washington, D.C.

(Continued on page 88)



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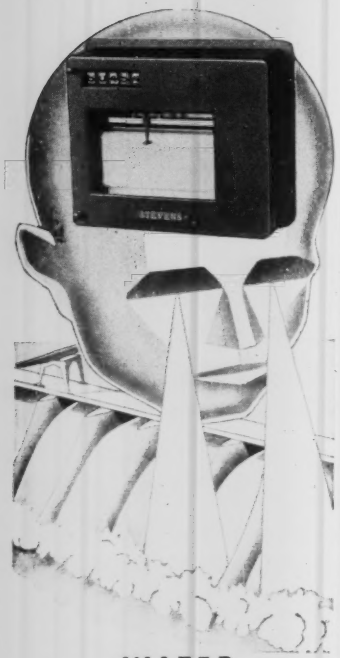

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New Publications

(Continued from page 87)

President's Highway Safety Program. Information received from all the states and 600 cities on the progress of the Action Program for highway safety, and proposals for the future are consolidated in *Priorities in the Action Program*. The primary purpose of the 1950-1951 inventory and guide for action, formulated by the President's Highway Safety Conference, is to alert state officials and the public to the mounting crisis of traffic accidents. Copies may be purchased for 35 cents from the Superintendent of Documents, U. S. Printing Office, Washington, D. C.

Water Pollution. A pattern for intergovernmental and civic cooperative action on the growing problem of pollution of the nation's water resources is set forth in a new publication of the Public Health Service, entitled *Clean Water Is Everybody's Business*. The booklet describes the effect of water pollution on all aspects of life and explains how a program of public action can be carried out to develop comprehensive water pollution control programs, stimulate construction of treatment works, provide technical aid and research, encourage recovery and use of waste products, and invoke enforcement measures when necessary. Single copies are available without charge from the Public Health Service, Federal Security Agency, Washington, D. C., and quantity orders from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 20 cents each.

Sewerage Facilities. The Public Health Service announces that copies of its report, *Statistical Summary of Sewage Works* in the United States, Supplement 213 to *Public Health Reports*, may be obtained from the Water Pollution Control Division, Public Health Service, Washington 25, D. C. The report summarizes basic data on the country's sewage works which first appeared in the 1945 Inventory of Water and Sewage Facilities covering all communities of over 100 population in the United States.

Aerodynamic Stability. Availability of Parts I and II in the University of Washington's projected series on the aerodynamic stability of suspension bridges, with special reference to the Tacoma Narrows Bridge, is announced. Part I covers all laboratory studies conducted prior to the design of the new laboratory in which wind-actuated dynamic models were investigated, and Part II the theoretical analyses of the natural modes of vibration of the bridge and the models as influenced by their various physical properties. Inquiries concerning both parts, which are issued as Bulletin No. 116 of the Engineering Experiment Station, should be addressed to the University of Washington Press, Seattle, Wash.

Engineering Research. A comprehensive definition of the role of research in engineering education, compiled by representatives of 83 leading engineering schools, is the central theme of *Research Is Learning*, new non-technical publication of the Engineering College Research Council of the American Society for Engineering Education. Free copies are available on request to the Secretary of the Engineering College Research Council, Room 7-204, 77 Massachusetts Avenue, Cambridge 39, Mass.

Wood Preservation. The 1950 issue of the annual Proceedings of the American Wood-Preservers' Association is available from the office of H. I. Dawson, secretary-treasurer of the AWPA, 839 Seventeenth St., N.W., Washington 6, D.C. A feature of the 587 page volume is a ten-year index for the years 1940 to 1949. Also included are the committee reports, contributed papers, and resultant discussion presented at the association's annual meeting in Houston, Tex., last April.

Pavement Design. Current methods for the design of flexible and rigid pavements are summarized by Robert Horonjeff and John Hugh Jones in a 100-page publication, entitled *The Design of Flexible and Rigid Pavements*. Issued as University of California Syllabus No. 319, the volume collates and organizes data previously not available. Included are design methods practiced by the Corps of Engineers, the Canadian Department of Transport, the Civil Aeronautics Administration, and the California and Kansas State Highway Departments. Copies may be purchased from the Associated Students' Store, University of California, Berkeley 4, Calif., at $2.50 each.

(Continued on page 90)

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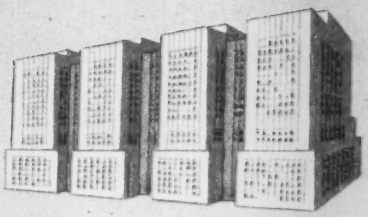

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New Publications

(*Continued from page 88*)

Fire in War. The study of *Fire Effects of Bombing Attacks*, based on a summary of data accumulated in World War II, has been prepared for the National Security Resources Board by the Civil Defense Liaison Office, Office of the Secretary of Defense. Designed to give guidance and assistance to civil defense services in preparing to combat mass fires, the report presents problems of extinguishment and control of mass fires resulting from bombing, discusses the principal factors of susceptibility to fire characteristic of all cities, and suggests methods of appraising them for the purpose of defense. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., for 15 cents.

Sao Paulo Improvements. A report on the *Sao Paulo Program of Public Improvements*, sponsored by Ibec Technical Services Corp., has been prepared under the direction of Robert Moses. In addition to detailed recommendations for a mass transportation system, a highway network, development of parks, sewage disposal systems, and mapping and zoning, the report presents suggestions for financing the program. Inquiries should be addressed to Ibec Technical Services Corp., Room 5117, 30 Rockefeller Plaza, New York, N.Y.

Hydraulic Research. Circular No. 3 of the St. Anthony Falls Hydraulic Laboratory at the University of Minnesota provides a current listing and brief description of publications and motion pictures available. Copies of the circular are available from the Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis, Minn.

Brick and Tile Engineering. Engineering data on brick and tile construction are compiled in a 392-page volume, *Brick and Tile Engineering*, published by the Structural Clay Products Institute. Written by Harry C. Plummer, director of engineering and technology for the Institute, the volume contains latest available engineering information on clay masonry construction. It may be purchased from the Structural Clay Products Institute, 1520 18th Street, N.W., Washington 6, D.C., for $5.

Solar Heating. The most important English and foreign papers published on the various aspects of solar heating between 1930 and 1950 are listed in *Bibliography on Domestic and Industrial Applications of Solar Heating*. Historical and general articles, as well as industrial and residential applications of solar heating are considered in this ESL Bibliography No. 7, which may be purchased from the Engineering Societies Library, 29 West 39th Street, New York, N.Y., for $2.

Cement Research. The new research and development laboratories of the Portland Cement Association at Skokie, Ill., are described in a pictorial brochure, *Dedicated to Progress*. The publication also includes an account of the organization's other widespread activities. Inquiries should be addressed to the Portland Cement Association, 33 West Grand Avenue, Chicago, Ill.

Ohio River Pollution Abatement. Substantial progress in the Ohio River Valley's regional program of pollution abatement is revealed in the *Second Annual Report, 1950*, of the Ohio River Valley Water Sanitation Commission, which reports numerous treatment plants in various stages of construction and design. This summary of the Commission's work may be obtained by writing to the Ohio River Valley Water Sanitation Commission Headquarters, 414 Walnut St., Cincinnati, Ohio.

Foreign Engineering Work. Information and advice for engineers interested in working in foreign lands is made available in *Going Abroad for Business* by Edmund B. Besselievre, M. ASCE, of the Foreign Division, The Dorr Company, Engineers, New York. The publisher is the Reinhold Publishing Corp., 330 West 42d Street, New York 18, N.Y., and the price $3.

Construction Training. Impending manpower demands make imperative assurance of a continuing supply of skilled workers for the construction industry, the Chamber of Commerce of the United States emphasizes in a pamphlet *Related Instruction—A Key to Apprentice Training in Construction*, prepared by its Construction and Civic Development Department Subcommittee on Apprenticeship and Training. The booklet is available at ten cents a copy from the Chamber's Construction and Civic Development Department, Washington 6, D.C.

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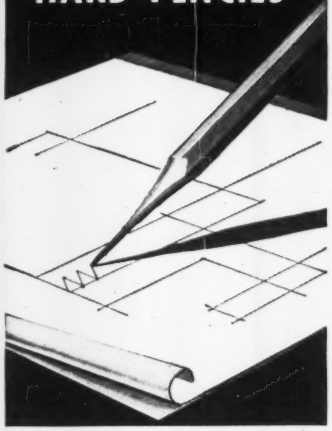

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Capital Improvement. Cleveland's *Six-Year Capital Improvement Program* is described by the City Planning Commission in its Eighth Annual Report. Trend of improvements, budget for 1951, and a program for 1952–1956, are some of the considerations included in the report. Inquiries should be addressed to the City Planning Commission, 501 City Hall, Cleveland, Ohio.

Industrial Research. The ninth edition of the directory, *Industrial Research Laboratories of the United States*, is now available from the National Research Council. The 445-page volume contains information on the research laboratories of 2,845 industrial and commercial organizations, including the names of the president and research executives, the personnel of the research laboratories, the fields of research activity, whether any consulting services are offered, and the size of the laboratory library. Appendixes give the same information for government laboratories which cooperate with industry, and the other listings for universities and colleges offering research services to industry. The new edition may be ordered from the Publications Office, National Research Council, 2101 Constitution Ave., Washington 25, D.C., at $5. Checks should be made payable to the National Academy of Sciences.

Meetings and Conferences

American Concrete Institute. Headquarters for the 47th annual convention of the American Concrete Institute will be the St. Francis Hotel, San Francisco, Calif., February 20–22.

American Concrete Pipe Association. The American Concrete Pipe Association will hold its 43rd annual meeting at the Waldorf-Astoria Hotel, New York City, March 1–3.

American Institute of Mining and Metallurgical Engineers. Papers on the Illinois Basin area will be presented at the annual meeting of the American Institute of Mining and Metallurgical Engineers in the Statler Hotel, St. Louis, Mo., February 17–22.

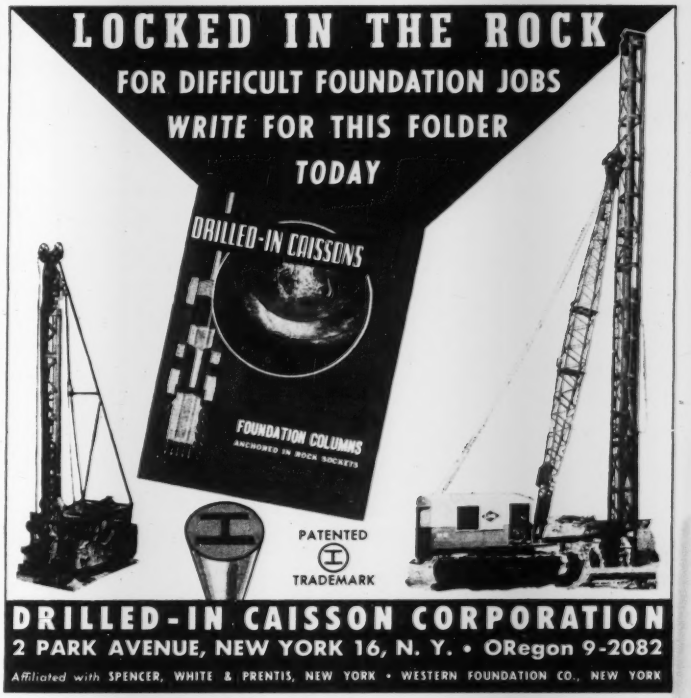
American Society for Testing Materials. The spring meeting of the American Society for Testing Materials is to take place at the Netherlands-Plaza Hotel, Cincinnati, Ohio, March 5–9.

Associated General Contractors of America, Inc. Problems on mobilization will be discussed during the annual convention of the Associated General Contractors of America, at the Statler and Copley-Plaza hotels, Boston, Mass., February 26–March 1.

Illinois Conference on Highway Engineering. Various aspects of highway engineering will be discussed at the 37th annual Illinois Conference on Highway Engineering in Urbana, February 20–22.

Second Structural Engineering Conference. Sponsored by the University of Florida, the Second Structural Engineering Conference will be held on the campus in Gainesville, on March 16 and 17.

Sixth Industrial Waste Conference. Developments in waste disposal and utilization will be discussed during the Sixth Industrial Waste Conference, at Purdue University, Lafayette, Ind., February 21–23.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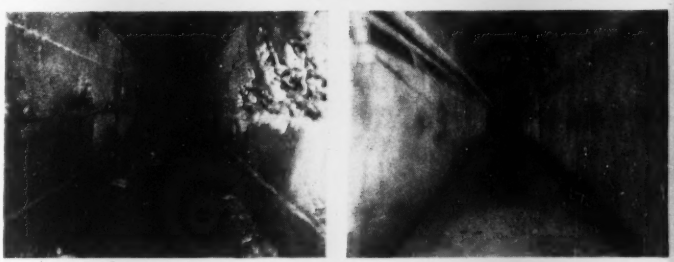

Old Sewer Gets New Life with "GUNITE"

The picture at the left shows an old concrete storm sewer in Washington, D. C., badly disintegrated and honeycombed. Flow value was low due to roughness. This sewer was reconditioned by chipping away the worst areas, sandblasting the entire surface and applying a "GUNITE" lining.

The smooth brush-finish increased its capacity sufficiently to meet all requirements, making it unnecessary to build a new sewer. The completed job is shown at the right.

Many money saving applications of "GUNITE" are described in our illustrated Bulletin B2400. Request on your letterhead will bring you a copy.

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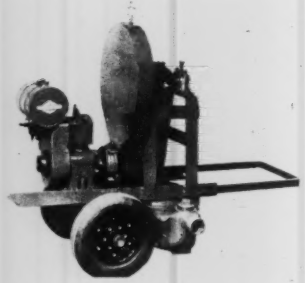
EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST,, AS REPORTED BY MANUFACTURERS

Diaphragm Pumps

TWO LIGHT WEIGHT mud hog diaphragm pumps are now being produced. Weighing only half as much as other mud hog pumps, they can be lifted on and off of trucks by two men and easily wheeled around difficult construction jobs by one man. Although the pumps are exceptionally light in weight, they are strongly constructed to give many years of maintenance free service. Primarily intended for seepage control and ditch work, the light weight mud hogs will lift from levels 25 ft below the pump and handle liquids



The Mud Hog

almost heavy enough to shovel. According to laboratory and field tests by the manufacturer, the 2 in. Model 202 will handle up to 2100 gph while the 3 in. 302 Model will pump up to 3200 gph. Both models are mounted on a rigid steel chassis equipped with 12X3.00 hollow cushion rubber tires. Flow of liquid through the pump is direct and free from obstructions. The pump body is separated from the chassis by removing only four cap screws, making it exceptionally easy to change diaphragms. The pumps are powered by a 2 hp Model 8-R6 Briggs and Stratton engine, equipped with a 6 to 1 geared speed reduction. Power is transmitted to the pump crank shaft by an oil lubricated chain drive. The chain drive is equipped with an adjustable tensioning device and is completely protected by an easily disassembled guard. The crank shaft is solidly supported on both ends by self-aligning bearings. There is no overhanging drive shaft to develop missalignment and cause weaving, broken shafts, bearing failure, eccentric failure, or other maintenance problems. The crank shaft is connected by an adjustable steel shaft to a standard #3 diaphragm, of a newly developed rubber and fabric composition which lasts twice as long as previously available diaphragms. **Marlow Pumps, Box 566, Ridgewood, N. J.**

Pontoon Tide Gate

A PONTOON TIDE GATE which has sufficient buoyancy to permit opening under a 2 in. differential head, has been developed. The wall casting and frame are made from high test cast iron, while the flaps are constructed entirely from genuine Byers wrought iron plates and membranes making a multiple number of watertight compartments continuously welded inside and outside from $^3/_8$ in. thick plates. These have facing strips finely machined which seal against $1^1/_2$ in. square rubber seating strips in dovetailed grooves. The use of genuine wrought iron gives protection against deterioration. **Krajewski-Pesant Mfg. Corp., N. Y.**

Trukmixer

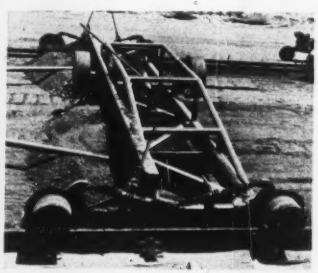
THE MODEL LITE-WEIGHT Hi-Boy Trukmixer, the lightest weight standard complete truck mixer available, has just been announced. The Hi-Boy has a tremendous reduction in weight, improved performance and provides extreme accessibility. The weight of the 3 cu yd model has been reduced by a full ton and the $4^1/_2$ cu yd model by a half ton, without sacrificing any of the ruggedness required in truck mixer construction. A few of the

The Hi-Boy

many features that eliminate excess weight and improve performance are: a 3-way, non-by-passing piston type water valve that makes possible a greatly simplified piping system; a new double-strand roller chain drive which automatically compensates for misalignment between drum and drive shaft caused by operation over rough roads; and a new compact and simplified transmission of most modern automotive design. The design of the revolving hopper for charging and discharging has not been changed, neither has there been any change in the ability of the Hi-Boy to mix and discharge even zero slump concrete. Complete details may be obtained from the **Blaw-Knox Div., Blaw-Knox, Co., Pittsburgh, Pa.**

Sub-Grade Planer

THE SUB-GRADE PLANER, which will cut an accurate sub-grade for concrete paving up to 25 ft wide, is now being manufactured. Designed to answer the demand for a heavy duty, rigid machine which will not deflect under extreme loads, it is especially suitable for airport work. Its 10,000 lb weight and sturdy construction make it possible to carry excess dirt forward to where needed. The blade will cut from 6 to 14 in. in depth and is instantly adjustable up and down by rachet jacks acting independently on each wheel.



Designed for Heavy Duty

The curved moldboard uses standard grader blades for flat grades, or special grades, or special blades can be furnished to cut any contour of grade desired. The sub-grade planer is easy on forms because of its Timken bearing automotive type wheels. Pull bars easily attach to tractor. Timken bearing transportation wheels can be quickly raised or lowered for moving. A removable tongue is provided for trailing. **Shovel Supply Company, P.O. Box 1369, Dallas 1, Texas.**

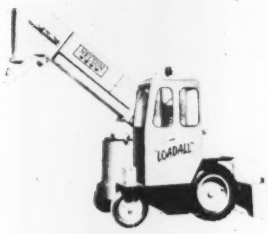
Steel Tape

THE "LEADER" is a new departure for long steel tapes, and is now available with a maroon-colored Vinylite covered case. The case resists water, will not stain or scuff, and has a roller type, throat, a flat stainless steel edge band that is flush inset and an attractive name plate. A nickel plated winding mechanism has a folding flush handle opened by a push pin. The chrome-clad line is corrosion resistant, will not chip, crack or peel. Black markings contrast sharply with the satin finish for easier reading, are bonded to the steel line and sunk below the surface for protection against wear. The tapes come in 25, 50, 75 and 100-ft lengths. **The Lufkin Rule Co., Saginaw Mich.**

Equipment, Materials & Methods (Continued)

Loadall

AN ALL-PURPOSE LOADER known as the "Loadall" has been introduced. It is the only machine now in production that will handle sand, snow, gravel, coal, cinders, humus, leaves, salt, etc., without belt changes or use of special attachments. The machine is specifically designed for the smaller municipality or contractor with year-round truck loading problems and a limited budget. It serves just as



All-Purpose Loader

effectively in loading road-patching materials in summer as in the heaviest of winter snows. The Loadall travels under its own power at road speeds up to 10 mph with working speeds to 6½ mph; loads heavy materials at from 1¾ to 2¼ cu yds per minute—snow at from 6 to 8 cu yds per minute. 24 in spirals have replaceable toothed digging edges, and it is powered by a 4 cylinder, air-cooled gasoline engine. Complete information is available from the **N. P. Nelson Iron Works, Inc., Clifton, N. J.**

Paving Breaker

A LIGHT-WEIGHT 50-LB PAVING breaker that has the power of many heavier breakers, is announced. The RC-50 is light enough to be handled by one man in horizontal or overhead work—making it adaptable to a wide range of uses. It is especially suitable for brick-work, asphalt-cutting and shop maintenance work. The RC-50 incorporates the same type Reed-Cleco valve as that used on the heavier paving breaker, the RC-80. This valve gives full control on both power and return strokes, assuring hard, uniform blows, fast action, minimum recoil, no short-stroking and low air consumption. Despite its light weight, the RC-50 has proved in service to be extremely rugged. Wear-resistant alloys, automatic lubrication and heavy-duty construction assure long life and low maintenance costs. Information may be obtained by asking for Bulletin RC-949, **Cleco Div., Reed Roller Bit Co., 5125 Clinton Dr., Houston 20, Tex.**

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THEY'RE KOPPERS PRESSURE-CREOSOTED PILES

● Never underestimate the damage that marine borers can do to untreated wood in salt water. In three to six months, they'll sometimes *honey-comb* untreated piles. In one year, they caused $3,000,000 worth of damage in a single American harbor.

The 76-foot piles pictured below have been pressure-creosoted by Koppers. This treatment protects piles against marine borers *and* decay—the two greatest threats to useful service life. Thirty years from now, based on case histories of similar installations, these Koppers Pressure-Creosoted Piles will *still* be sound and serviceable.

For piers, wharves, groins, jetties, breakwaters—in fact, wherever water and construction meet—get the protection that Koppers Pressure-Creosoting Treatment provides. Koppers Treating Plants deliver pressure-creosoted piles on schedule . . . sizes up to 130 feet are available. Quotations gladly furnished.

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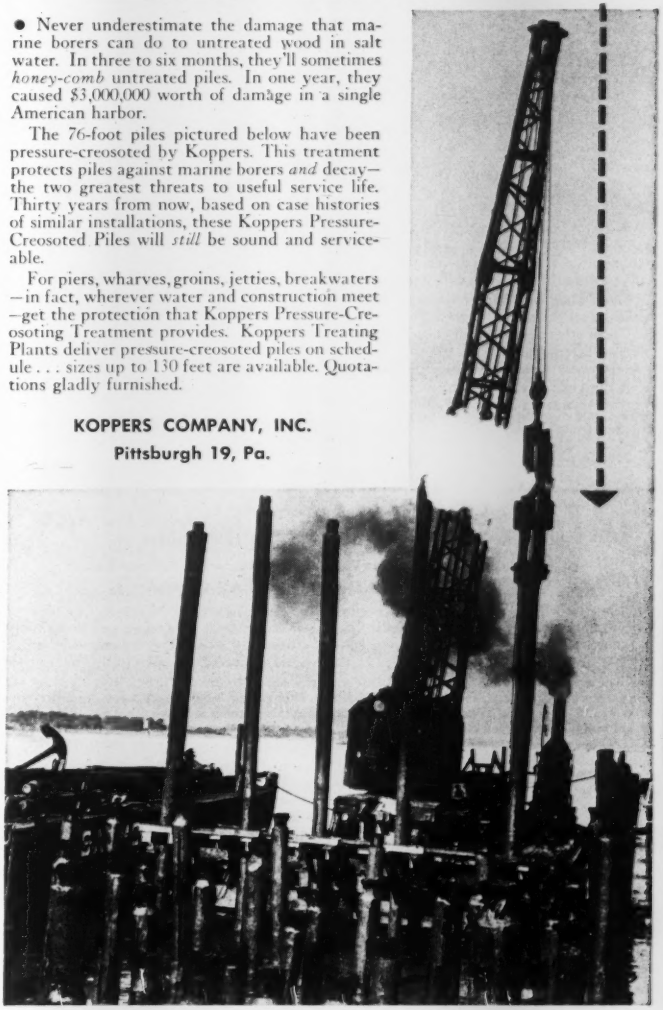
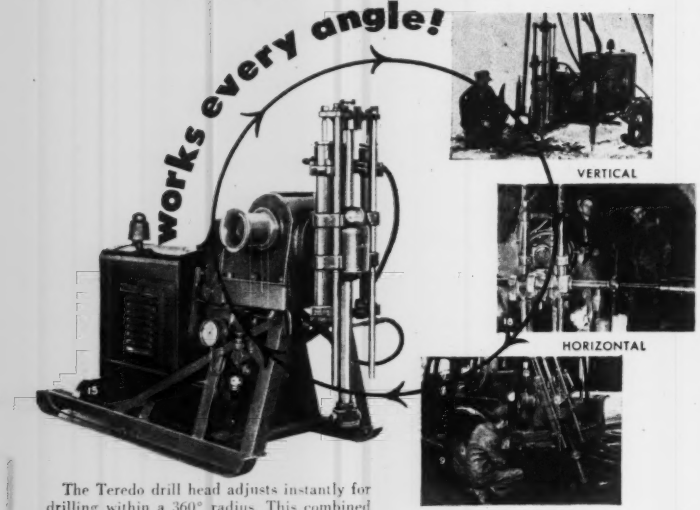


Foundation piles being driven for the 150-foot extension of the U. S. Coast Guard pier at Charleston, S. C.

KOPPERS PRESSURE-TREATED WOOD

The NEW Acker Teredo Drill...



The Teredo drill head adjusts instantly for drilling within a 360° radius. This combined with other Acker features such as built-in pumps, cargo-type winches, hydraulic or screw feed heads, choice of power plant, mounting on drag or any type of vehicle, are bound to save time, labor and on-the-job costs.

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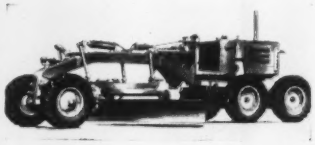
Equipment, Materials & Methods (Continued)

Motor Grader

AN IMPORTANT FEATURE of the No. 104 motor grader is the transmission. It is of the constant mesh type and is claimed to be designed in its entirety for the specific and complete needs of heavy-duty motor grader operation. The short, compact and sturdy transmission permits smooth, easy gear shifting without clashing of gears. Only one lever is needed for all shifting—either forward or reverse. Six overlapping forward speeds provide a range of 1.1 to 20.1 mph. The performance of the transmission has proved six speeds to be completely satisfactory for all work or travel requirements. Two reverse speeds are provided. The extreme high reverse of 8.4 miles per hour permits fast operation from one end of the job to the other without the need of turning the machine around—especially desirable where space is narrow and limited. Listed as standard equipment are a combination of hand steering with hydraulic booster and large front tires same size as rear tires. A hydraulic shiftable moldboard is available as extra equipment. It greatly facilitates blading operations, and provides a maximum extension of the blade 97 in. beyond rear tires with a 12 ft moldboard. Weight is from 21,840 lbs up, depending on extra equipment. **The Galion Iron Works & Mfg. Co., Galion, Ohio.**



Model 104

Materials Handling Conference

MANY PROBLEMS OF MATERIALS HANDLING in the construction industry, as well as civil engineering, sewage disposal and water supply, will be considered at the Materials Handling Conference which will be held concurrently with the National Materials Handling Exposition at the International Amphitheatre, Chicago, April 30–May 4, inclusive. The conference is the most extensive ever undertaken in the field. Construction and civil engineering executives also will find scores of machines specially suited to the industry among the thousands which will cover ten acres of exhibit area, both indoors and out. The six acres of exhibits and the outdoor area of four acres will comprise the most extensive display ever assembled of cost reducing handling equipment in operation. Admission to both the exposition and conference will be free. Advance registration cards may be obtained from **Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.**

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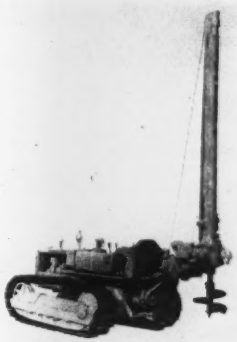
Equipment, Materials & Methods (Continued)

Earth Auger

THE TRACKSON MODEL EA4 earth auger is now available. A fast, dependable, earth boring and pole setting machine, the earth auger assures construction firms, telephone, telegraph and power companies, railroads, and highway departments a full range of boring positions for drilling holes vertically or at any usable angle. The Model EA4 will drill holes 9 in. to 24 in. in diameter, to a depth of 8 ft with the standard 13 ft bar or to a depth of 11 ft with the optional 16 ft bar. Larger diameter holes can be bored under certain conditions. The solid auger bar is square, permitting full bearing contact through the driving head. It has a 5,000 lb capacity which handles poles up to 50 ft in length. The auger unit is compactly mounted on the Caterpillar D4 Tractor for running over rough ground or working in close quarters. The tractor has the 5-roller non-oscillating track frame, large front idlers and 16-in. grouser tracks which provide stability and balance in all types of terrain. It is an ideal unit for drilling holes for poles, anchor holes or tower footings and for setting power line poles. Heavy duty track roller guards are offered as added protection for operations under adverse conditions. Caterpillar Tractor Co., Peoria 8, Ill.



Model EA4

Squirrel Cage Induction Motors

THE LINE OF TYPE QZE, totally enclosed, non-ventilated, squirrel cage, induction motors has recently been extended to include continuous duty ratings built in NEMA standard frame 284. At present, 7½ hp, 1800 rpm and 5 hp, 1200 rpm motors are in production. These motors conform in all respects to NEMA and ASA standards for totally enclosed machines and are identical in mounting

(Continued on page 96)

Para-Plastic . . .
NARROW STRIP for
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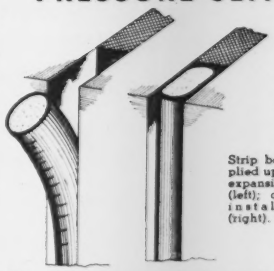

Strip being applied upward in expansion joint (left); complete installation (right).

Para-Plastic Pressure Seals, available in several types — solid Para-Plastic or Para-Plastic coated Sponge Rubber — are the easy, economical answer to joint sealing problems in existing contraction joints or contraction cracks in vertical or sloping masonry. Para-Plastic maintains bond with concrete from 0° to 180° — is resilient, plastic — keeps joint sealed at all times. Write for complete information on Para-Plastic Pressure Seals.

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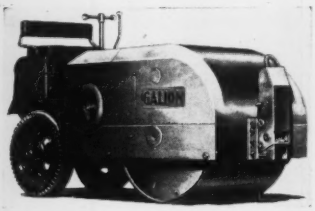
Equipment, Materials & Methods (Continued)

dimensions with standard totally enclosed, fan-cooled motors of the same ratings. They are admirably suited for service in adverse locations where dirt, dust, lint, metal turnings and sand are prevalent, since there are no ventilating openings to clog. Rotors are the indestructible "Copperspun." Ball bearings are of the cartridge type with ample grease space to permit sealing for the life of the bearing if desired, but with provisions for easy flushing and regreasing. Conduit boxes are the dual type—a most valuable feature where space is limited. For further information, ask for Bulletin 1215. **Fairbanks-Morse & Co., 600 South Michigan Ave., Chicago 5, Ill.**

Portable Roller

SEVERAL ADVANCEMENTS have been made in the variable weight portable roller. Steering is now done by hydraulic power under finger-tip control. A rugged spur gear final drive replaces the old chain drive, and a constant-mesh transmission eliminates gear-clashing and assures smooth gear-shifting. Other improvements are: easily adjusted Twin Disc, over-center, forward and reverse clutches; new design hydraulically operated towing hitch which folds back compactly against roller housing when not in



Steered Hydraulically

use. The compaction effectiveness of the portable roller is said to equal that of a conventional 5-7 ton tandem roller. Compression under roll, without water ballast, is listed at 130 lbs per inch of roll width. With 2300 lbs of water added to the roll, compression is raised to 192 lbs per inch. The compression roll is unusually large for a portable roller—48 in. diameter by 42 in. wide. It is fitted with mats and sprinkler system. For information write **The Galion Iron Works & Mfg. Co., Galion, Ohio.**

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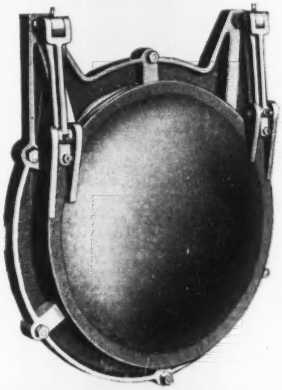

Fig. B-68. Type M (Circular) Gate

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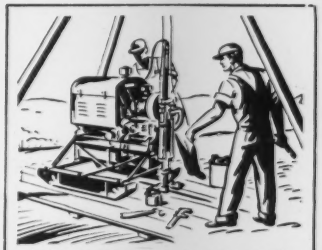
Literature Available

BRIDGES—A brochure entitled, "Permanent Timber Bridges" is offered. There are illustrations and diagrams of the deck arch, girder, bowstring truss, composite deck and parallel chord bridges. **Timber Structures, Inc., N. W., 29th & Yeon Ave., Portland 8, Ore.**

CRANES—A 20-page, two color book covers the application of Lorain cranes to industrial material handling. It contains over fifty illustrations showing Lorains on-the-job in many types of industries, handling many types of material. Steel sheet, sand, scrap, pulpwood, sugar cane, paper, tires, airplanes are just a few of the materials these versatile machines can handle efficiently. Rubber-tired motocranes and self-propelled Lorains and crawler mounted models are shown working in many types of industry. **Thew Shovel Co., Lorain, Ohio.**

CONDENSER CIRCULATORS—Condenser circulators, in standard sizes to 100,000 G.P.M., and in special sizes to 200,000 G.P.M. are illustrated and described in Catalog No. G-1050, just issued. Designed for power station service, the pumps described are vertical, mixed-flow units of large capacity and low head. Simple in design and compact in construction, they are capable of handling larger volumes of water at lower cost than any other type of efficient pumping equipment. "Pull-out" type units are also illustrated in the catalog. These units permit removal of all operating parts without pulling out the complete pump or disturbing pipe connections. The catalog, "Circulators by Economy," may be obtained by writing **Economy Pumps, Inc., Div. of Hamilton-Thomas Corp., Hamilton, Ohio.**

PERMALITE LIGHTWEIGHT AGGREGATES—An 8-page, 2-color general brochure on Permalite lightweight aggregates is now available. It is separated into two main sections; one on lightweight plaster and the other on lightweight insulating concrete. In the plaster section, such data as advantages and uses of lightweight plaster and complete data on recommended mixes and applications are included. Fireproofing with lightweight plaster is thoroughly covered. In the section on Permalite lightweight insulating concrete, such data as the advantages, uses, typical applications and complete technical data covering complete mix design information, including materials required per cu yd for concrete, typical properties, mix proportions by volume are included. One page is devoted to the subject "What is Permalite." This is a general résumé of the product. Technical data covering Permalite concrete mix design information is given together with the advantages of its use and typical applications—its manufacture and its constant development through research. **Great Lakes Carbon Corp., Building Products Div., 18 East 48th St., New York, 17, N.Y.**



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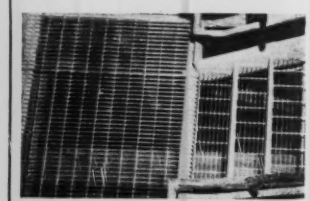

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Literature Available (Continued)

SWAGED ASSEMBLIES—An informative folder shows Cablecraft swaged assemblies. It describes the latest practical improvements and application of swaged fittings to wire rope and strands. On the back page are assemblies cable data for the very small cords and strands which are not generally found in most wire rope catalogs. **Cablecraft Engineering Co., 515 N. Cushman Ave., Tacoma 6, Wash.**

LIGHT-WEIGHT PIPE—A bulletin showing typical applications of Lockseam spiralweld pipe in the construction, dredging, materials handling, mining, oil, paper mill, power plant, and sewage disposal fields has just been released. The bulletin includes data on fittings, flanges, connections, and pipe specifications from 4 in. to 30 in. in diameter—information of help to pipe users in all fields. **Naylor Pipe Co., 1230 East 92nd St., Chicago 19, Ill.**

CORRUGATED STEEL SHEETING—How to use lightweight corrugated steel sheeting to effectively control movement of soil or water is described in an illustrated 10-page booklet. Entitled "Armco Steel Sheeting for Trenches, Cofferdams, Cutoff Walls, Shore Protection," it points out where interlocking and flange type sheeting can be used to advantage. Also included in the booklet is data on driving and properties of both types of sheeting as well as a method of figuring sizes and spacing of wales and struts. **Armco Drainage & Metal Products, Inc., Middletown, Ohio.**

CRANES—A 24-page, two-color brochure that will have unusual interest for contractors, engineers and construction men is just off the press. Its pages are packed with big, dramatic pictures of the nation's greatest dam jobs—Garrison, Friant, Grand Coulee, Bull Shoals and many others. The pages in pictures tell better than words how dam builders use the tremendous size, power and reach of revolver cranes on some of the world's biggest construction jobs. **Sales Promotion Dept., American Hoist & Derrick Co., St. Paul 1, Minn.**

WATER CONDITIONING—A leafet, "No 160 Series—Corrosion Inhibitor," 25X-7582, describes the manner in which the No. 160 series corrosion inhibitor acts by neutralization and by surface absorption to control the corrosion of steam and condensate lines. The corrosion inhibitor is a mixture of the most effective organic amines selected according to volatility characteristics required by each steam condensate system. It is a colorless liquid with a slight odor and contains no ammonia. Use of the inhibitor is recommended where economic considerations do not justify expenditures for deionizers or sodium-hydrogen zeolite softeners. Copies are available from **Allis-Chalmers Mfg. Co., 1187 S. 70th Street, Milwaukee, Wis.**

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Closed to Further Discussion

D-XVI. Discussion of Paper, **Stream Flow Variability,** by E. W. Lane and Kai Lei.

D-XVII. Discussion of Paper, **End Restraints on Truss Members,** by Harold E. Wessman and Thomas C. Kavanagh.

D-XVIII. Discussion of Paper, **Frequency Analysis of Beam and Girder Floors,** by Hans H. Bleich.

D-XIX. Discussion of Paper, **Roads and Pavements, Sampson Naval Training Station,** by Jacob Feld.

D-XX. Discussion of Paper, **Aerodynamic Theory of Bridge Oscillations,** by D. B. Steinman.

26. Industrial Stream Pollution Abatement, by L. L. Hedgepeth.

27. Plasticity of Metals—Mathematical Theory and Structural Applications, by D. C. Drucker, Assoc. M. ASCE.

28. Retrogression on the Colorado River Since 1935, by J. W. Stanley.

29. Sedimentation Studies at Conchas Reservoir in New Mexico, by D. C. Bondurant, Assoc. M. ASCE.

30. Economic Effects of Reservoir Sedimentation, by W. E. Corfitzen, M. ASCE.

31. Measurement and Analysis of Suspended Sediment Loads in Streams, by Martin E. Nelson and Paul C. Benedict.

32. Effect of Skew Angle on Rigid-Frame Reactions, by Walter C. Boyer.

33. Strength of I-Beams in Combined Bending and Torsion, by Basil Sourochnikoff.

34. Lateral Buckling of Eccentrically Loaded I-Section Columns, by H. N. Hill and J. W. Clark.

35. Design Curves for Footings on Soil, by Winfield A. McCracken.

D-XXII. Discussion of Paper, **Analytical Method of Determining the Length of Transition Spiral,** by Michael V. Smirnoff.

D-XXIV. Discussion of Paper, **Diversion Tunnel and Power Conduit of Nantahala Hydroelectric Development,** by D. J. Bleifuss.

36. Impossibility of Performance in Contracts for Engineering and Construction, by Robert F. Borg.

37. Design of Prestressed Tanks, by J. M. Crom.

38. Hydrology of Mexico, by Andrés García-Quintero.

39. Practical Design of Solid-Barrel, Reinforced-Concrete Skew Structures, by Bernard L. Weiner.

40. Technique of Passing Floods Over Earth Dams During Construction, by Andrew Weiss.

Summarized in Earlier Issues

D-XXVI. Discussion of Paper, **A Study of End Connections for Struts,** by Marshall Holt and J. W. Clark.

41. Ship Response to Range Action in Harbor Basins, by Basil Wrigley Wilson.

42. Wind-Load Standards in Europe, by John W. T. Van Erp.

43. Settlement Correction at La Guardia Field, by John M. Kyle.

44. The Problem of Wave Action on Earth Slopes, by Martin A. Mason.

45. Comprehensive Plan for the Columbia Basin, by William Whipple.

D-4. Discussion of Paper, **Capillary Phenomena in Cohesionless Soils,** by T. William Lambe.

D-5. Discussion of Paper, **Elastic Restraint Equations for Semi-Rigid Connections,** by J. E. Lothers.

D-10. Discussion of Paper, **Pollution Abatement Policy,** by Thomas R. Camp.

D-XXIII. Discussion of Symposium, **High-Velocity Flow in Open Channels.**

D-XXVIII. Discussion of Paper, **Movements in the Dessicated Alkaline Soils of Burma,** by F. L. D. Wooltorton.

46. Human Aspects of Mexican Irrigation, by Antonio L. Rodriquez.

47. Operation and Maintenance of Irrigation Systems, by Raymond A. Hill.

48. Compaction of Cohesive Soils: Progress Report of the Subcommittee on Consolidation of Materials in Earth Dams and Their Foundations of the Committee on Earth Dams of the Soil Mechanics and Foundations Division.

D-XXVII. Discussion of Symposium, **Design Characteristics of Lock Systems in the United States: A Symposium.**

D-2. Discussion of Paper, **Public Utility Condemnation Cases in the State of Washington,** by Henry L. Gray.

D-3. Discussion of Paper, **Treatment of Foundations for Large Dams by Grouting Methods,** by A. W. Simonds, Fred H. Lippold and R. E. Keim.

D-9. Discussion of Paper, **Atchafalaya Diversion and Its Effect on the Mississippi River,** by Leo M. Odom.

Third Notice

49. Large Hyperbolic Functions Computed by Fisson, by F. T. Llewellyn. Hyperbolic sines and cosines are often required in the solution of cubic and quartic equations encountered in structural analysis. The primary object of the paper is to simplify this work for adaptation by practical designers and computers. The method is more precise than that of interpolation by proportional parts, and adequate precision is attained much more readily than by academic methods. Examples for solution by slide rule are included. (Available January 1).

50. Supersonic Sounding Instruments and Methods, by Joseph M. Caldwell. The historical development of echo sounders is described, together with the comparative advantages of portable versus fixed, sonic versus supersonic, and recording versus indicating types of echo sounders. The action and reliability of echo sounders over various types of bottoms and with surface wave action are dis-

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cussed from factual test results obtained under normal operating conditions. Numerical comparisons of simultaneous soundings taken with lead-line and echo sounder are presented for both firm bottom and soft bottom conditions. (Available January 1.)

Second Notice

51. Laterally Loaded Plane Structures and Structures Curved in Space, by Frank Baron and James P. Michalos. Two analytical procedures—in the form of analogies—are developed for structures continuous between two supports. Results are interpreted in terms of a pressure line concept. A "shear and torsion analogy" is presented for arches, bents, and balcony girders loaded normal to their plane. Assumed moments are balanced by correction moments computed as shear stresses in an analogous strut. A general procedure is developed for structures curved in space and loaded in any direction. Such structures may be used, for example, in urban freeway design. (Available February 1.)

52. Some Aspects of Electronic Surveying, by Carl I. Aslakson. Surveying and mapping techniques are undergoing revolutionary modifications as the result of advances in electronics. Commander Aslakson, who has been actively engaged in the development of long distance electronic measuring techniques since 1944, discusses these changes. Commander Aslakson recently reported a new measurement of the velocity of radio waves by long distance electronic measurements. His value has recently been offered by British and Swedish scientists as corroboration for adoption of a new velocity of light which is about 1 part in 20,000 higher than the previously accepted value. He also reports that such rapid advances in accuracy are being made that publication dates cannot keep pace with developments. (Available February 1.)

53. Wedge-Beam Framing, by Arsham Amirikian. Wedge-shaped members, having tapered flanges and webs, constitute elements of a new type of framing. These members are joined by an alternating series of rigid and flexible connections to form assemblies which provide appreciable economies and lend themselves to a simple analysis. The paper contains suggested arrangements of framing, details of connection and a method of analysis. As an aid in design, the analysis is reduced to the formulation of a series of simultaneous equations involving a limited number of redundants, which are set directly, through tabular guides, and their solution is obtained by a simplified procedure. (Available February 1.)

54. Truss Deflections by the Coordinate Method, by Kuang-Han Chu. The method described in the paper is an algebraic equivalent of the Williot-Mohr diagram. By adopting a set of simple sign conventions and by suitable arrangement in tabular forms, the work is minimized. This method, like the Williot-Mohr method, is in many respects superior to many available algebraic methods for determining truss deflections as it determines both vertical and horizontal components of the movements of all joints in a truss. Moreover, it is preferable to the graphical Williot-Mohr method in that it can be carried to any degree of accuracy. (Available February 1.)

55. Measurement of Sedimentation in Small Reservoirs, by L. C. Gottschalk. The standard field practices of the Soil Conservation Service, in the assembly of sedimentation data, are described. Equipment and methods of sounding for water depths and silt thicknesses are given, and surveying procedures discussed. This paper should be considered as a companion to Separate No. 50, "Supersonic Sounding Instruments and Methods," by Joseph M. Caldwell. (Available February 1.)

First Notice

56. Turbulent Transfer Mechanism and Suspended Sediment in Closed Channels, by Hassan M. Ismail. The relation between momentum transfer and sediment transfer in smooth, closed rectangular channels was studied. Application of this relation makes possible evaluation of momentum transfer coefficients at the central region of the channel using direct suspended load measurements. The paper describes the effect of sand in suspension on the universal constant of turbulent exchange, distribution of momentum transfer coefficient and the coefficient of friction. (Available March 1.)

57. Design of Irrigation Systems, by W. H. Nalder. An account of the planning and design considerations entering into the development of irrigation features of multiple-purpose projects of the Bureau of Reclamation is presented. Reviewed are the major factors affecting irrigation development and their attendant engineering implications, the elements of an irrigation system, and the influence of economics on design. The principal features of three Reclamation multiple-purpose projects are described. (Available March 1.)

58. Highway Planning in Turkey, by H. E. Hilts. Engineering activity in Turkey as a result of United States assistance, under the "Point Four" program, is recorded. The problem involves highway improvements in a nation somewhat larger than the State of Texas comprising 12,500 miles of national highways, 13,500 miles of provincial roads, and about 62,500 miles of city streets, village streets, and rural roads. The paper outlines preliminary organizational and planning details. (Available March 1.)

59. Limit Design of Beams and Frames, by H. J. Greenberg and W. Prager. A method of limit design of statically indeterminate beams or frames under load is presented. The limit moments under which individual sections act as hinges are presumed known throughout the structure, and a safety factor against collapse is sought. Two extremum principles for this factor are established. (Available March 1.)

60. Surveying and Mapping Requirements For Modern City Planning, by Charles A. Blessing. An outline of the need for reasonable standardization of mapping and surveying procedures by the city-planning commissions in all cities, large and small is presented. The paper suggests map types and scales which have been found useful in a number of cities and proposes a revision of ASCE Manual No. 10 to include a more definite statement of surveying and mapping requirements for modern city planning from the point of view of the city planner, who is the user of the survey. (Available March 1.)

D-7. Discussion of Paper, **The Geochemistry of Earthwork,** by Hyde Forbes. The original paper, published in March 1950, presented observational and test data relative to the geochemical processes and the mineralogical changes set up in working with earth, in excavations and in engineering structures. Discussers are: Warren D. Smith, D. P. Krynine, S. S. Gorman, Charles H. Lee, George S. Harman, and Hyde Forbes. (Available March 1.)

D-25. Discussion of Paper, **Numerical Computation of Buckling Loads by Finite Differences,** by Mario G. Salvadori. The original paper, published in December 1949, explained the buckling problems that may be obtained by purely numerical computations, using a procedure of successive approximation. Discussers are: I. K. Silverman, Bruno A. Boley, G. R. Ramaswamy, Chi-Teh Wang, George Hermann, and Mario G. Salvadori. (Available March 1.)

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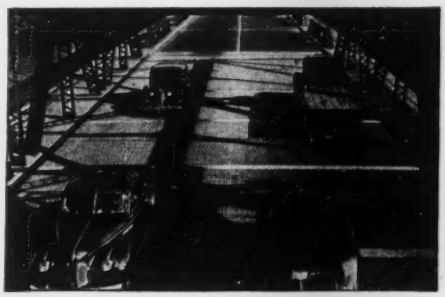

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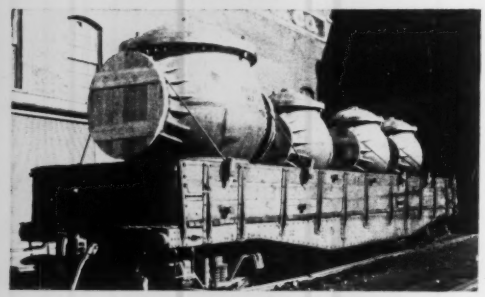

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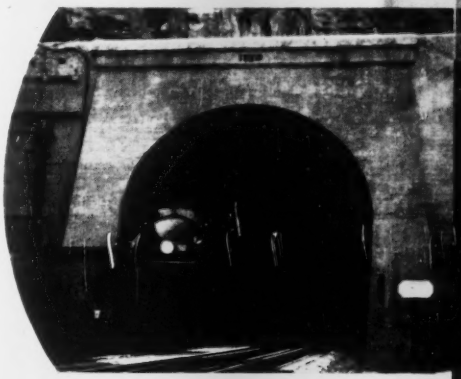

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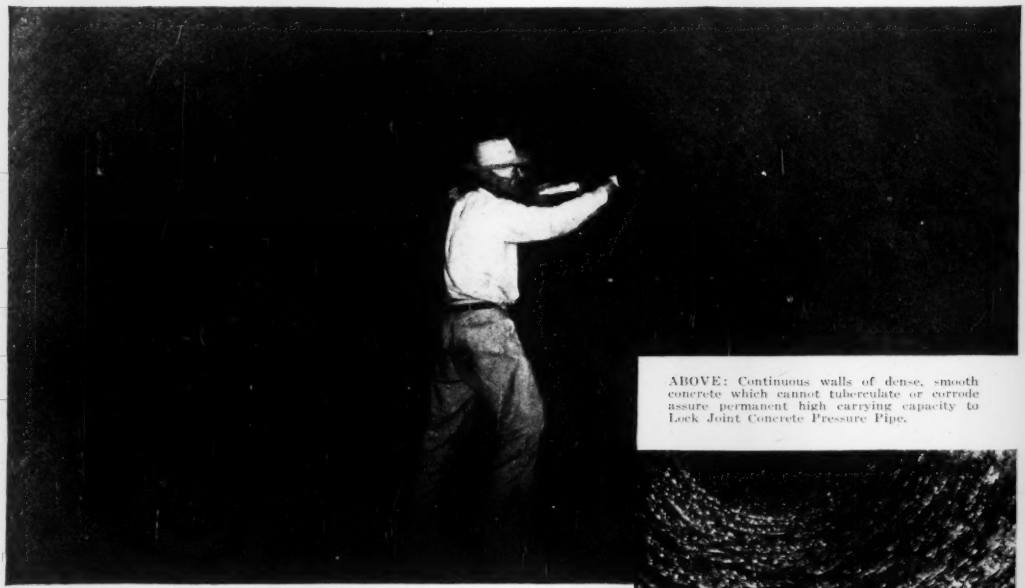

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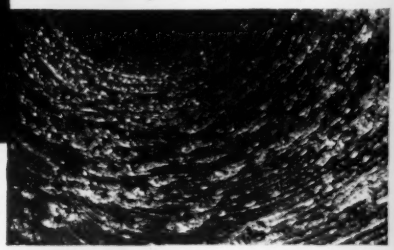

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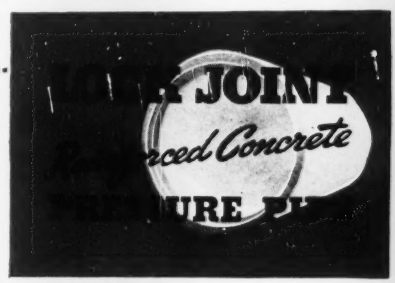

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